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**CHEMICAL WEAPONS OF FOREIGN ARMIES AND
ANTICHEMICAL PROTECTION**

by

A. Malchinskiy

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Sp/7 Edward Lachowicz
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Chemical Research and Development Laboratories Special Publication 4-23
CHEMICAL WEAPONS OF FOREIGN ARMIES AND
ANTICHEMICAL PROTECTION

APPROVED:


J. P. MITCHELL
Director of Technical Services

CONTENTS

<u>Chapter</u>	<u>Page</u>
INTRODUCTION	3
I. TOXIC CHEMICAL AGENTS AND THEIR EMPLOYMENT.....	5
A. Toxic Chemical Agents.....	5
B. Means of Employing Chemical Agents.....	24
II. PROTECTION AGAINST CHEMICAL ATTACK	33
A. Classification and Assignment of Means of Protection Against Chemical Attacks	33
B. Individual Protection	34
C. Collective Protection Against Chemical Agents	56
D. Protection of Food, Water, and Articles of Everyday Use Against Contamination by Chemical Agents	60
E. First Aid After Contamination by Chemical Agents	61
F. Identification of Chemical Agents.....	64
G. Means and Methods of Decontamination	65
III. PROTECTIVE MEASURES AND RULES FOR PUBLIC CONDUCT..	92

INTRODUCTION

The term chemical weapons usually includes the toxic chemical agents¹ used in combat and the means by which such agents are disseminated. These means include chemical aerial bombs, aerial spraying devices, guided and free missiles containing chemical agents, artillery chemical shell, etc. The casualty effect of chemical weapons results from the chemical agent, which, when used in combat, can contaminate unprotected people and animals. Casualties caused by the action of chemical agents are defined as any disruption of normal life activities in an organism ranging from temporary irritation of the eyes or respiratory tract, to serious or fatal injuries.

Chemical agents can be used for combat purposes in a liquid or solid state. Some of the liquid chemical agents are distinguished by their higher viscosity and are called viscous compounds.

Chemical agents are converted from a liquid or solid state to a "combat" state after their release from aerial chemical bombs or artillery chemical shell, or after being sprayed or disseminated as blanketing films. Liquid chemical agents are converted to vapor (gas), or fog,² or drops of various sizes when disseminated, but solid agents are converted to smoke.³ In the combat state, chemical agents contaminate large volumes of air and large areas of the ground, bringing mass contamination to unprotected people and animals. When these agents are employed as a vapor, or fog, or smoke, they contaminate the air, but when they are in a liquid state, they contaminate the ground and surrounding objects. Agents used to contaminate the ground will gradually evaporate, and, thus, the air above the contaminated area will also become contaminated. Consequently, the air also becomes contaminated in all cases where liquid agents are used. Smoke or fog frequently settles upon the ground (or buildings) and then gradually evaporates; the evaporation of some agents may last for a long time.

Chemical weapons to contaminate troops were used for the first time in World War I. Civilian populations were seldom exposed to chemical attacks, because the combat techniques of those days did not include possibilities

1. In Russian, the term "toxic chemical agent (s)" is denoted by the word ОТРАВЛЯЮЩЕЕ (IE) VESHESTVO (A), or in abbreviation as: OE (B = V in English). Thus, the abbreviation OE frequently appearing in the book is interpreted in singular and plural as meaning toxic chemical agent (s).
2. Fog contains very small particles of liquid agent suspended in the air.
3. Smoke contains very small solid particles of agent thinly atomized in the air.

of a mass employment of chemical weapons deep in the enemy's rear areas. For various reasons, which are not considered essential to the discussion, chemical weapons were not used during World War II. This does not imply, however, that, if imperialists start the next war, they will renounce the employment of chemical weapons. After World War II, certain imperialistic governments not only continued (and still continue) to develop chemical weapons, but also used them in their aggressive war against the peace loving Korean nation.

The Soviet Union as a defender of the cause of peace, which is supported by foreign policy, still stands for peaceful coexistence among all governments, for reduction of armaments and Armed Forces in the entire world, and for the prohibition of all types of weapons of mass destruction. Nevertheless, the Soviet people do not forget that the imperialists are preparing a new war in which atomic and hydrogen weapons would be used. Our people are engaged in peaceful creative work, but they will relentlessly strengthen the defensive power of their country.

The arming of modern aircraft with chemical weapons and the employment of drones for air attack with explosives containing chemical agents, not only expose troops but also civilians to the danger of chemical attack. The presently known agents are extremely toxic to humans, but none of them should frighten anyone, who knows how to use the means available for protection against chemical attack.

This booklet contains basic information about the means of chemical attack that may threaten our population, and information concerning measures for civilian protection. This booklet is intended for a broad distribution to readers, and may be used by civilian instructors of DOSAAF (Volunteer Society for Cooperation with the Army, Aviation, and Fleet) as a textbook for preparing lectures and discussions.

CHAPTER I

TOXIC CHEMICAL AGENTS AND THEIR EMPLOYMENT

A. Toxic Chemical Agents.

I. Effects of Chemical Agents on Humans.

The ability of chemical agents to cause poisoning is called toxicity.

Chemical agents are divided into the following four groups according to their effects on organisms and the characteristics of their toxicity: cutaneous vesicants (blister agents that affect the skin and mucosa); general systemic agents (agents that affect the blood and nervous system); eye irritants (agents that affect the eyes and upper respiratory tract); and asphyxiants (agents that affect the lungs).

The above grouping according to characteristic effects upon organisms is conditional, because many agents can cause simultaneous multiple reactions; e. g., a cutaneous-vesicant reaction and a general toxic reaction, or an asphyxiant reaction and an irritant reaction, etc. Each agent has an inherent and most typical action, however, which is followed by a unique specific reaction. The above grouping permits the establishment of approximate classifications of known agents.

Chemical agents can contaminate unprotected individuals in the following manner: through the skin, after drops or a spray have touched the skin; after a person has made contact with terrain or with the objects contaminated by an agent; by inhaling air contaminated by toxic agents; through the mucosa of the eyelids, cornea, and conjunctiva of the eyes, and through the mucosa of the nose and throat; upon contact with a liquid or solid form of an agent, and when a person stays too long in an atmosphere contaminated by toxic vapor, fog, or smoke; and through the digestive organs, after poisoned food or water has been consumed.

The action of an agent may be general or local. In the former case, the agent absorbed into the blood through the skin, or through the mucous and respiratory organs, spreads through the entire organism and disrupts the activities of many organs. During local reaction only that part of the organism that comes into direct contact with the agent becomes contaminated. (If a local reaction develops complications, a general poisoning of the organism may follow.)

I. Lacrimators.

In most cases the action on the human organism is instantaneous. There are agents, however, whose toxic signs do not appear for several hours (2 to 12 and more) after entry into an organism. Such agents have a period of latent action, during which their toxic effects do not appear.

2. Combat Persistency of Chemical Agents.

The time during which agents retain their toxicity in the air or on the ground is called the combat persistency of the agent.

Combat persistency depends upon the physical and chemical characteristics of the agent, upon condition of the agent when used in combat, upon weather conditions, and upon the topography of the locality.

Among the physical characteristics of greatest importance to combat persistency are boiling point, volatility, and ability to penetrate the ground and various materials.

The lower the boiling point of an agent, the faster it evaporates and the lower its combat persistency.

The volatility of an agent is the maximum possible quantity of vapor in the air at a determined temperature. Volatility increases with an increase in air temperature. Agents with lower volatility take longer to evaporate, and their toxicity persists for longer periods.

Agents that are easily absorbed by the ground and materials leave little residue on the ground and on those materials, and lose their ability to contaminate at a faster rate.

The most suitable agents for a prolonged contamination of the ground are those that possess low volatility, high boiling points, and low absorption rates into the ground and materials.

Among the chemical properties of decisive importance to agent persistency are reactivity with water, reactivity with atmospheric oxygen, and reactivity with substances on the ground, such as coverings, vegetation, etc. Agents that do not react easily with these substances will continue to persist for longer periods on the ground, vegetation, various coverings, and buildings and in wells or in the air.

The combat persistency of an agent is determined in large measure by the combat conditions in which it is employed. Agents with the lowest

persistence are those used in the form of vapor, fog, or smoke. The agents with the highest persistence are those in liquid form.

The meteorological factors influencing persistence of chemical agents are air temperature, temperature of the ground, wind, and precipitation, in that order. Higher air and ground temperatures speed evaporation of agents, which will consequently lose their contaminating power faster.

Temperature also influences the persistence of agents in the air. During hot summer days, the lower layers of air heat up considerably, and their density decreases more than the density of the upper, and much cooler, layers. Consequently, convection occurs with a shifting of the lower and upper strata of the air. Convection tends to cause rapid dispersion of agents. An inversion phenomenon frequently occurs from sunset to sunrise because the ground cools faster than the surrounding air. As a result, heat is withdrawn from the lower strata of air, and these layers of air become much cooler and more dense than the upper layers. Consequently, the lower strata of air remain stable at the ground surface for a longer time, and when agents enter these layers, they retain their persistence for a longer time.

A substantial influence on the persistence of an agent is also exerted by the isotherm; i. e., the average degree of stability of the air according to the vertical incidence. The characteristic of the isotherm is that, in it, the temperature of the layer of air 20 m to 30 m from the ground remains approximately the same. This phenomenon is observed during murky weather, in the summer during morning and evening hours in fair weather, and during winter. The combat persistence of an agent will be higher in the presence of an isotherm than in the presence of a convection, but it will be lower than in the presence of inversion.

Wind greatly influences the concentration¹ of an agent in the air. A strong wind will cause a concentration to decrease more rapidly because of dispersion of the contaminated air, and, consequently, the agent retains its contaminating power for a much shorter time. The evaporation of chemical agents becomes intensified with an increase in wind velocity, which strongly

1. Concentration denotes the quantity of agent found in one unit of volume of contaminated air. Concentrations are usually expressed in milligrams of agent per liter of air. A concentration of air capable of causing contamination is called the combat concentration. Combat concentrations differ considerably. They can vary from fractions of milligrams to tens of milligrams of agent per liter of air, depending on the type of agent used, what its mission is, and by what means it is delivered.

influences the density of contamination¹ of liquid agents on the ground. An increase in wind velocity from calm to 6 to 7 m/sec, for example, rapidly decreases the contamination density and reduces the persistency of agents on the ground by a significant proportion.

Precipitation, primarily rain, influences the concentration of agent in contaminated air, and the agent's persistency. Rain causes particles of toxic smoke to settle on the ground, and, thus, rapidly reduces the concentration of smoke in the air. Rain intensifies the intermixing of air strata and causes acceleration of the dispersion of contaminated air. Moreover, rain washes off agents that have settled on the ground. If an agent is soluble in water or reacts chemically with water, the influence of rain on combat persistency is intensified. Only a heavy rain has, however, a practicable capability of decreasing the combat persistency of an agent.

The topography of a locality, its vegetation, and the type of ground also significantly influence upon the combat persistency of an agent. Stagnation of contaminated air may develop and last for a long time (up to several hours) in narrow and deep natural terrain features such as ravines, gorges, gullies, etc. Inasmuch as winds do not blow through any deep natural terrain features, the evaporation of agents that contaminate such places will be much slower. Thick vegetation also prolongs the contamination time of an agent in a locality.

The evaporation of agents proceeds much faster from hard rocky terrain and from paved streets than from a soft soil.

Agents that have contaminated the air over populated areas, may settle and remain in the area for a long time (up to several hours). This is particularly true in cities that are densely built up and that have multistoried structures, in blind alleys, in apartments, and in other places having poor air circulation. The duration of the contaminating action of an agent would be prolonged under these circumstances.

It can be concluded from the above that the combat persistency of chemical agents is determined primarily by the physical and chemical characteristics of the agents. All agents are usually categorized as persistent

1. The density of contamination is the quantity of agent found (on the average) in one unit of a contaminated area. It is measured in grams of agent per sq m. The combat density of contamination usually amounts to several decagrams per sq m.

or nonpersistent agents, depending on these characteristics.

Liquid agents that have low volatility, high boiling points, low absorption by the ground, poor solubility in water, and poor reactivity with water, atmospheric oxygen, and other components of air and ground, are called persistent agents.

The combat persistency of the same agent can vary from several hours to many days, depending upon the weather and the other conditions under which it was used. The use of thickeners is another factor to be considered.

Gases and volatile liquids that possess comparatively low boiling points and that evaporate and disperse quickly in the air, and agents that readily decompose because of the effects of atmospheric humidity and oxygen are called nonpersistent agents. Solid agents that are used as toxic smokes can also be regarded as being nonpersistent. The combat persistency of these agents changes by minutes or decaminutes; it may even differ by several hours in some places.

The persistent agents, which are primarily intended for direct contamination of people, are dispersed in the form of drops, and are also used for contaminating the ground, buildings, and various other objects. If persistent agents are used in combat as a fog or vapor, they first contaminate the air, not the ground; in this combat state they very closely resemble the nonpersistent agents because they disperse rapidly in the air.

Nonpersistent agents are intended for the contamination of people by contaminating the air.

The characteristics of certain of the agents with which the armies of capitalistic governments are equipped, will be discussed in the following.

3. Cutaneous Vesicants.

a. Mustard.

Industrial mustard¹ is a brown oily liquid that smells like garlic or mustard. It evaporates very slowly in the air. Its boiling point is between 217°C and 219°C. It disintegrates frequently during boiling. Mustard solidifies at temperatures between 5°C and 10°C. Thus, during cold weather,

1. All agents prepared in large quantities by the chemical industry are, as a rule, chemically impure and contain certain amounts of various additives. These are called industrial products.

it is used with solutions of organic substances, which lower the temperature of solidification. Other agents, e. g., lewisite, may also be used with these organic substances.

Mustard dissolves with difficulty in water. It is almost 1 1/2 times heavier than water, and if drops of mustard fall into wells, they settle on the bottom. Mustard dissolves readily in kerosene, benzene, carbon tetrachloride, and several other organic solvents. This characteristic is used in the process of removing mustard from contaminated surfaces (mainly metallic).

Mustard also dissolves well in fats, and, therefore, penetrates readily through the pores of the skin, especially in places coated with grease. After mustard comes into contact with the human skin, its outward traces disappear within several minutes and only a perception of its odor remains.

Since mustard penetrates freely into all porous materials, it is also readily absorbed by clothing and footwear.

Liquid mustard penetrates a medium soft soil to a depth of 1 cm to 2 cm in the first few hours, and subsequently to 8 cm to 10 cm, or even deeper. It may even penetrate 30 cm or deeper in craters formed by the explosion of chemical aerial bombs. Loose snow may allow mustard to penetrate to 15 cm to 20 cm, but icy or densely packed snow can only be penetrated to 2 cm or 3 cm.

Liquid mustard penetrates plaster and bricks 1 cm to 2 cm and concrete up to 4 cm. Glass and rust-free metals retain mustard on their surfaces.

It will penetrate unpainted wood to a depth of from 2 mm or 3 mm to 15 mm (depending upon the type of wood). If wood is coated with an oil paint, the mustard dissolves in the paint and then only penetrates to a depth of 1 mm to 2 mm.

Mustard contaminates food to a depth of from 0.5 cm to 5 cm; fats and butter are completely contaminated.

Mustard disintegrates slowly in cold water, thereby losing its contaminating effects. The disintegration of mustard in hot water proceeds much faster. Thus, boiling is suggested as a method for decontaminating many objects.

Contaminated grass wilts and turns yellow within approximately 24 hours.

Some strong oxidizing agents, such as calcium hypochlorite, chloramine, etc., quickly disintegrate mustard and form harmless chemical compounds. This feature is used in chemical decontamination of objects contaminated by mustard and to decontaminate the ground and human, and animal skin.

Mustard is one of the most persistent agents. During summer, the agent will retain its contaminating effectiveness for from several hours to days in open areas, and from 3 to 5 days in forests or in bushy growth. In order to strengthen the persistency of mustard, certain thickeners are added. In a viscous state, mustard retains its contaminating effectiveness for several days in open places. During cold weather, it has considerably higher combat persistency than in warm weather, but it does not produce contaminating vapors. Thickened mustard loses its capacity to penetrate clothing and footwear.

Multiple contamination effects of a local and general type produced in an organism by mustard cause inflammation of all tissues and organs that the agent touches. The most characteristic effect is its blistering action. Strong lesions appear on the skin after liquid mustard touches it.

The indications of skin contamination usually appear within 4 to 8 hours after contact with the liquid agent, because it has a period of latent action. Mustard vapors produce the indications of skin contamination after 12 to 24 hours.

The first indications of contamination are erubescence and slight swelling (edema) of the skin, with sporadic itching.

These symptoms disappear without trace after 3 to 4 days in mild contaminations of the skin.

Much stronger contamination results in the appearance of small blisters on erubescant parts of skin, and the blisters contain a yellowish liquid. The blisters gradually grow larger, then fuse together into larger blisters. In 2 to 3 days the blisters burst open, and ulcers develop beneath the remaining coverings. The ulcers dry out and heal in 20 to 30 days. The treatment of suppurative ulcers may last for 2 months or even longer.

The symptoms of general poisoning resulting from percutaneous contamination can be observed even during the erubescant stage. Temperature rises, nausea and, sometimes, vomiting appear, and a general weakness

and depression are felt. A contaminated person grows thin rapidly, and death may follow from a serious general poisoning.

The eyes are extremely sensitive to the effect of mustard. Effects from vapor appear within 2 to 4 hours after contact with the agent. In lighter cases of contamination, a slight burning is felt in eyes, followed by sensitivity to light, lacrimation, erubescence of the eyelids, and edema of mucous membrane. All symptoms vanish in 6 to 15 days. In more serious cases, the eyelids swell considerably, the cornea becomes cloudy, and vision is impaired. Treatment may last from 1 to 2 months, and the victim usually recovers.

When liquid mustard gets into the eyes, it may cause ulceration of the mucous membranes and cornea; individuals may also lose their eyesight, partially or completely.

The inhalation of mustard vapors causes contamination of the respiratory tract. The first indications of contamination by the vapors are: irritated throat with congestion, pain during swallowing, coryza, coughing and hoarseness — all appearing in 1 to 12 hours and becoming aggravated in 1 to 2 days. The sickness is restrained in mild cases, and the symptoms disappear gradually. In serious cases, complications such as bronchitis, empyema of the lungs, etc., may develop.

After inhalation of a mixture of mustard vapor and fog, the first indications of contamination may appear in from 10 to 15 minutes. Later effects appear swiftly and in more aggravated form than those from the vapor alone.

The first indications of contamination of the gastrointestinal tract after ingestion of liquid mustard can be noticed in 30 to 60 minutes. The victim feels sharp pains in the abdomen, then nausea and vomiting appear; dysentery follows toward the end of the first few days. The next developments are involvement of the oral cavity, esophagus, stomach, and duodenum, with the symptoms of a general poisoning of the organism. Contamination of the gastrointestinal tract is very dangerous and is frequently fatal.

b. Distilled Mustard.

Distilled mustard is prepared from industrial mustard by distillation and washing; it contains approximately 5 % of sulfurous admixtures. The agent is a pale yellow oily liquid having a faint odor of garlic. It has a much stronger skin blistering effect than industrial mustard and is more stable in prolonged storage. It solidifies at temperatures of about 12°C to 14°C.

Mustard was widely used during World War I. Its combat value, which is determined by its multiple and strong effects upon organisms and by its considerable degree of persistency, is very high even today.

c. Lewisite.

Industrial lewisite is a brown, and sometimes almost black, oily liquid. The odor of lewisite vapor, in low concentrations, resembles the odor of geraniums. Lewisite is more volatile than mustard, and it can contaminate even in winter. The boiling point of lewisite is 190°C. Lewisite disintegrates during boiling. It does not solidify in cold weather, but thickens considerably in temperatures of -15°C to -20°C. It can, consequently, be used in cold weather without solvents, which are intended to lower the temperature of thickening. Lewisite dissolves with difficulty in water. Solvents that can be used for washing lewisite from contaminated objects are kerosene, benzene, alcohol, and other organic solvents. Lewisite is almost twice as heavy as water.

Grass and leaves quickly change to a red-yellow shading after contact with lewisite.

Lewisite disintegrates in water faster than mustard, but the products of disintegration remain toxic and affect the skin. Calcium hypochlorite, salts of hydrochlorite calcium, and other strong oxidizing agents rapidly neutralize the skin-blistering effects of lewisite. The agent also disintegrates under the influence of aqueous solutions of caustic alkali and sodium sulfide.

Lewisite causes rust formations on metal surfaces.

Food contaminated by lewisite becomes unfit for use and must be destroyed.

Lewisite is also a persistent agent, but its combat persistency is lower than that of mustard. Drops of lewisite contaminate the ground for a period of from 2 to 10 hours during summer and from 2 to 3 days during winter.

Combat persistency of this agent can be increased by increasing its viscosity.

Lewisite falling on wooden surfaces, bricks, and concrete retains its toxic effects up to 24 hours during summer and up to 7 days in winter.

Lewisite manifests its multiple effects upon the human organism and animals in a way similar to that of mustard, and it has many characteristics in common with mustard. Although it has its own peculiarities, lewisite does not have latent effect. Within several minutes after its drops touch the skin, erubescence, burning, and pain follow. Large blisters appear in 1 to 2 days.

Lewisite is absorbed by the skin much faster than mustard. This facilitates a faster development of general poisoning in an organism, as compared to mustard. The ulceration of the skin is less deep than that caused by mustard, and the ulcers heal in 20 to 30 days.

The indications of contamination appear instantly after inhalation of lewisite vapor: Congestion and burning in the nose and pharynx appear first, and this is followed by coughing, sternutation, salivation, and a profuse discharge from the nose. Lewisite vapors have immediate irritating effects as compared to mustard vapors.

The effect on the eyes is sudden and produces painful symptoms.

The inhalation of air containing high concentrations of lewisite vapor can cause edema of the lungs, which is characteristic of aftereffects caused by suffocative agents.

Lewisite was not used in combat during World War I because it was not discovered and studied until the end of the war.

d. Nitrogen Mustard.

Industrial nitrogen mustard is a dark liquid having a faint odor. It has a much lower volatility than mustard. Its boiling point is between 230°C and 233°C; it disintegrates during boiling and solidifies at -4°C. It dissolves with difficulty in water, but readily in benzene, kerosene, and other organic solvents.

Water disintegrates nitrogen mustard gradually, forming chemical compounds that have no harmful effects.

Strong oxidizing agents that neutralize mustard react in the same way on nitrogen mustard.

Nitrogen mustard is a persistent agent that produces the same multiple effects as mustard. A local contamination by nitrogen mustard is somewhat less severe, but the general toxic effect is considerably stronger

than that of mustard.

The erubescence of the skin, following contamination by nitrogen mustard drops, appears in 6 to 8 hours, and sometimes much later. Toward the end of the first few days, skin edema develops, and subsequently small blisters appear. They usually do not fuse into larger blisters, but dry and heal in 7 to 8 days. Nitrogen mustard vapor has a mild effect upon human skin and the skin of animals. When the eyes become contaminated by vapor of this agent, lacrimation and sensitivity to light develop.

The contamination effects of nitrogen mustard resemble those of mustard in other respects.

There are some inherent differences between nitrogen mustard and mustard. One of these is the low temperature at which the former solidifies.

This agent was not used in combat. Large quantities of the agent were found in Germany after World War II.

4. General Systemic Agents.

a. Tabun.

Industrial tabun is a reddish-yellow liquid with an odor resembling that of bitter almonds. Its volatility is very close to that of mustard. The solidification temperature of tabun is approximately -50°C . Tabun dissolves with difficulty in water and kerosene, but is readily soluble in acetone, benzene, methyl alcohol, and dichlorethane. It sinks in water and dissolves slowly, giving off prussic acid. Disintegration of tabun proceeds much faster upon co-action with alkali solutions.

The combat persistency of tabun is very similar to that of mustard. Tabun can also be used in viscous formulas.

Tabun is one of the agents that produce spasmodic-paralytic reactions. Its toxicity develops rapidly without any period of latent action.

Tabun causes a contraction of the pupils, intensified lacrimation and sweating, and bradycardia. A brief exposure to very low concentrations of tabun causes an impairment of vision and difficulty in breathing (approximately within 24 hours). This is followed by pain in the forehead and congestion in the thorax.

Serious contamination by tabun vapor or fog is manifested in the first few minutes by very difficult breathing and bradycardia, and sometimes by vomiting, diarrhea, trembling, and spasmodic contraction of individual muscles; this is followed later by strong convulsions of the entire body. The convulsions last from several minutes to 2 to 3 hours; death caused by respiratory failure and heart failure follows.

Tabun produces hardly any local skin effects, but if drops of this agent come in contact with unprotected skin and mucosa of the eyes and mouth, they are rapidly absorbed and causes a general poisoning of the organism; absorption of this agent through the mucosa proceeds faster than through the skin.

Tabun was not used in combat.

b. Sarin.

Sarin is a colorless liquid of somewhat lower volatility than tabun. As a chemically pure product, Sarin has no smell. The characteristics of the contaminating effects of Sarin resemble those of tabun, but Sarin is considerably more toxic. Near the end of World War II, two factories were built in Germany to produce Sarin.

c. Prussic Acid (Hydrocyanic Acid).

Prussic acid is a colorless and highly volatile liquid with an odor like that of bitter almonds. It boils at 26°C and solidifies at -14°C. It dissolves readily in water. Prussic acid vapor is somewhat lighter than air.

Prussic acid does not affect metals and fabrics. It dissolves readily in water, thereby losing its contamination effects. Upon interaction with caustic alkali, prussic acid forms toxic nonvolatile cyanide salts.

Prussic acid is a typical nonpersistent agent. Its combat persistency in summer and winter does not exceed 15 to 20 minutes.

Food is contaminated by this agent for only a very short time; it is suitable for use and retains its nutritive and gustable qualities after proper airing.

Prussic acid vapor is usually quickly absorbed into the blood, which is then deprived of the opportunity to absorb oxygen and to deliver the oxygen to tissues of an organism. As a result, the interstitial (cellular) respiration

becomes paralyzed. Contamination by prussic acid is manifested mainly through the central nervous system.

After inhalation of air containing high concentrations of prussic acid vapor, instantaneous poisoning occurs; lower concentrations of this agent bring a delayed action. The instantaneous poisoning can cause death in several minutes. The developments are as follows: after several breaths of air contaminated by this agent, the affected person faints, becomes unconscious, struggles in violent convulsions, and dies as a result of respiratory and heart failure.

A delayed type of poisoning may develop after a comparatively long time. A bitter taste appears in the mouth, followed by irritation of the throat, dizziness, general weakness, and a sensation of fear. If a person is exposed briefly to a low concentration of prussic acid, the symptoms quickly disappear. With a more serious poisoning, additional symptoms appear, such as strong dyspnea, slowing of the pulse, mydriasis, and dimming of consciousness, the gait becomes staggered, the mucosa changes to light red, and a poisoned person may faint. Later, unconsciousness and sensitivity appear and violent convulsions follow. The muscles become relaxed; breathing is more shallow and infrequent and finally stops. With respiratory failure, the heart continues to function for several minutes. This is important to remember, when first aid is given to the victim.

Poisoning by prussic acid is usually very severe. Death follows within minutes, or in 1 hour after inhalation of this agent. If death has not occurred within this time, a person recovers rapidly. A delayed form of poisoning that may be fatal within several days is rare.

If poisoning has not reached the stage of respiratory paralysis and the victim obtains first aid, complete recovery usually follows. If respiration fails, the victim can be saved with the aid of special antidotes if the heart continues to function.

Very low concentrations of prussic acid vapor may have no effect upon an individual even when he remains in a contaminated atmosphere for a long time.

Prussic acid was used during World War II.

d. Cyanogen Chloride.

Cyanogen chloride is a colorless gas that has a unique odor. Upon cooling to 13°C , it thickens and becomes liquid. It solidifies into a crystalline

mass at temperatures near -6°C .

Cyanogen chloride dissolves readily in water and in organic solvents. Water disintegrates this agent slowly, producing minor toxicants; alkali accelerates disintegration of cyanogen chloride.

This agent has effects very similar to those of the general systemic agents because its toxic reactions resemble those of prussic acid; it also causes irritation of the eyes and respiratory tract. Cyanogen chloride was used in World War I.

e. Carbon Monoxide.

Carbon monoxide is a colorless and odorless gas. It was not used as a poisoning agent. Contamination by carbon monoxide is possible during fires and detonations of high-explosive aerial bombs inside buildings and underground, because carbon monoxide forms as a result of the incomplete combustion of organic substances. The content of carbon monoxide may be as much as 70% among other gases present during detonation.

Carbon monoxide does not contaminate food and water; it does not react with metals and fabrics.

Since carbon monoxide has no irritant effects, poisoning may occur unnoticed. When carbon monoxide is inhaled, it becomes absorbed by the blood, where it combines firmly with the hemoglobin. The supply of oxygen to the tissues of an organism becomes disrupted, and oxygen starvation follows. Poisoning by carbon monoxide produces a feeling of tinnitus aurium, dizziness, headache, difficult breathing, rapid heart beat, nausea, vomiting, and weakness; the fingernails and lips become bluish. A serious poisoning causes unconsciousness and convulsions; death follows because of respiratory paralysis and heart failure.

5. Irritant Agents.

a. Adamsite.

Industrial adamsite is a powder or a fused dark green mass that is almost odorless. Its boiling point is 410°C . At normal temperatures adamsite is almost nonvolatile. Upon heating, or as a result of detonation, it forms a toxic smoke of yellowish shading. Smoke is the only combat form of adamsite.

The agent is not soluble in water and does not decompose in water. Water cannot become contaminated by adamsite smoke, but if an aerial chemical bomb containing adamsite explodes in a small reservoir, the water would be contaminated for a long time.

Food becomes contaminated by adamsite only on the surface. Upon removal of contaminated layers, it can be eaten again. Adamsite smoke does not contaminate the ground and does not react with metals and fabrics.

Adamsite causes a sharp irritation of the respiratory tract. After 20 to 30 seconds of exposure to adamsite smoke of measurable concentration, an individual feels a sharp pain and burning in the thorax and pain in the jaws and frontal sinuses. This is followed by salivation, coughing, sneezing, a profuse discharge from the nose, nausea, and sometimes vomiting. Removal from exposure to adamsite smoke brings recovery from the effects in 1 to 3 hours.

The inhalation of low concentrations of adamsite smoke results only in the perception of its odor during the first few minutes. After 5 to 10 minutes, the effects appear, and a person is rendered unfit for work for 20 to 30 minutes, even if removed from the contaminated atmosphere.

Adamsite was not used in combat; it was discovered in 1918.

b. Diphenylchlorarsine.

Industrial products of diphenylchlorarsine appear as dirty-yellow or brown crystals and have a faint odor resembling that of onions. It boils at a temperature of approximately 330°C and disintegrates; it is almost non-volatile. Diphenylchlorarsine becomes sublimed during heating and changes to smoke. It is only used in the form of smoke, which has a grayish shading. Diphenylchlorarsine is not soluble in water and does not decompose in it. Its persistency and its effects on metals, fabrics, food, fodder, and water are the same as those of adamsite.

Diphenylchlorarsine affects humans in the same way as does adamsite, but it has no latent period of action, and its aftereffects disappear faster than do those of adamsite.

The agent was used in World War II.

c. Chloroacetophenone.

Industrial products of chloroacetophenone look like yellow, brown, or colorless crystals and have a pleasant odor resembling the odor of blossoms.

of the bird cherry. It evaporates very slowly at normal temperatures and boils at 246°C. It becomes sublimed during heating and converts to a smoke. Chloroacetophenone also turns to smoke after detonation. The smoke has a bluish-white color. The agent is almost nonsoluble in water and does not decompose in it. Food becomes slightly contaminated by chloroacetophenone smoke, but only on the surface. Metals and fabrics are not affected by the smoke of this agent.

The smoke of chloroacetophenone does not contaminate the ground, but during hot weather the volatility of the agent increases to such a degree that if its smoke particles settle on the ground and on vegetation, they evaporate and form chloroacetophenone vapor that can produce irritant reactions for 2 to 4 days.

Chloroacetophenone dissolves slowly in water and alcohol solutions of sodium sulfide and loses its irritant properties.

Chloroacetophenone smoke causes sharp irritation of the eyes, burning sensations, colic, lacrimation, and blepharospasm. In serious cases, sensitivity to light, spasmotic closing of the eyelids, and sharp pain in the eyes occur. Irritation in the upper respiratory tract, rasping sensibility in the throat, a burning sensation below the sternum, salivation, discharge from the nasal mucosa, and coughing also occur. The human skin, especially when hot and moist, may develop a sense of itching and of mild burning, redness and sporadic small blisters may also appear.

All these symptoms vanish quickly after removal from contaminated air or the donning of a gas mask.

Chloroacetophenone vapor affects an individual much less severely than its smoke. The effects of vapor are usually confined to irritation of eyes. Solutions of chloroacetophenone with chloroform or with some other substances can be used to cause prolonged contamination of the air by vapor of the agent, after the ground has been sprayed with such solutions.

Chloroacetophenone was not used during World War I, but it was adopted after the war by many armies of capitalistic countries.

6. Asphyxiants.

a. Phosgene.

Phosgene is a colorless gas, 3 1/2 times heavier than air. It has

an unpleasant odor resembling that of fusty hay, or rotting fruits. Phosgene changes gradually to a volatile liquid under pressure, or when cooled to below 8°C. Industrial liquid phosgene is a yellow, or yellow-brown substance that evaporates rapidly because of its high volatility. It dissolves with difficulty in water, and as it dissolves it forms harmless substances. It disintegrates rapidly in alkali.

Phosgene corrodes iron and steel slowly in the presence of moisture, and it lowers the durability of fabrics and bleaches them. Food exposed to the effects of phosgene vapor usually becomes absolutely harmless after airing or boiling, and is then edible. Practically speaking, phosgene does not contaminate water.

Phosgene is a nonpersistent agent and is used as a gas. The persistency of phosgene in open areas during summer is estimated to last from 15 to 20 minutes, and it extends to 2 or 3 hours in stagnant places. Phosgene's persistency increases by several factors in winter.

Phosgene contaminates people and animals only through the respiratory organs. After inhalation of phosgene, an individual has a sweet unpleasant aftertaste (especially while smoking), a hacking cough then appears, and some dizziness and general weakness follow. All symptoms appear in mild form, but only when the concentration of phosgene is low. The symptoms vanish rapidly after fresh air is breathed. The victim usually recovers within 4 to 6 hours and is unaware that a serious contamination occurred. Subsequently, violent pulmonary edema that is frequently fatal may develop.

The symptoms of serious poisoning by phosgene are as follows: difficult, accelerated, and shallow breathing; intensified coughing with a profuse discharge of foamy-liquid sputum (frequently mixed with blood); increased pulse rate and temperature; headache, dizziness, pain around the sternum, and sore throat; weakness, difficult breathing, rapid heart beat; and bluish color of cheeks, ears, wrists, and feet. The results of contamination depend upon the quantities of phosgene absorbed by the organism and upon the physical resistance of the organism during the period of phosgene's latent action. The higher the resistance, the more difficult the development of the consequences of contamination. If death has not occurred within the first 2 days, the victim usually recovers. Recovery occurs in most cases in 20 to 30 days, but in more complicated cases (pneumonia or pleurisy) it may take 2 months, or even longer. If very high concentrations of phosgene are involved, there is practically no period of latent action, and all of the symptoms develop quickly and violently.

Phosgene was used widely in World War I and is still retained as one of the weapons of the armies of many capitalistic countries.

b. Diphosgene.

Diphosgene is a colorless or brown transparent liquid, with an unpleasant odor very similar to that of phosgene. Its boiling point is 128°C; it disintegrates when heated to the boiling point and liberates phosgene. Diphosgene evaporates in air rather slowly and does not solidify during winter.

It dissolves with difficulty in water, slowly disintegrating to carbon dioxide and hydrochloric acid. The disintegration of diphosgene becomes suspended after several minutes of boiling in water. Caustic alkalis, ammonia, and sodium sulfide decontaminate this agent quickly.

Diphosgene vapor reacts on metals, fabrics, food, and fodder in the same way as do the vapors of phosgene, but not as strongly.

Diphosgene retains its contamination effects in summer for 30 to 60 minutes in open air. In winter, its contamination effects in an open place may last several hours. Diphosgene is vaporlike in its combat form, and in some instances, foglike. Diphosgene vapor and fog usually form upon detonation of chemical aerial bombs containing the agent. Vapor also develops after evaporation of liquid diphosgene in craters formed by the explosion of chemical aerial bombs. Liquid diphosgene can also be mixed with other agents such as mustard or lewisite, and used in aerial bombs and aerial spray devices.

Diphosgene resembles phosgene with regard to the type and strength of the effects of contamination, but the irritant effects of diphosgene are manifested more sharply, especially on the eyes.

Diphosgene was used extensively in World War I by the German Army; it has been adopted as one of the chemical weapons by many capitalistic countries.

The names of chemical agents used in various countries, as found in the literature, are given in the following table together with their chemical formulas.

TABLE 1

CHEMICAL AGENTS OF VARIOUS COUNTRIES

Agent	Chemical designation	Chemical formula
Mustard (lost-Ger., mustard gas, yellow cross agent)	Dichlorodiethyl sulfide	$\begin{array}{c} \text{CH}_2\text{CH}_2\text{Cl} \\ \diagdown \text{S} \diagup \\ \text{CH}_2\text{CH}_2\text{Cl} \end{array}$
Lewisite	Chlorovinylchlorarsine	$\text{ClCN}=\text{CHAsCl}_2$
Nitrogen mustard	Trichlorotriethylamine	$\begin{array}{c} \text{CH}_2\text{CH}_2\text{Cl} \\ \diagdown \text{N} \diagup \\ \text{CH}_2\text{CH}_2\text{Cl} \\ \diagdown \text{CH}_2\text{CH}_2\text{Cl} \end{array}$
Tabun ("trilon" 83)	Diethylamide of ethyl ether of cyanophosphonic acid	$(\text{CH}_3)_2\text{NP} \begin{array}{c} \diagup \text{OC}_2\text{H}_5 \\ \diagdown \text{CN} \end{array}$
Sarin (saran, "trilon" 46)	Acid fluoride of isopropyl ester of methylphosphonic acid	$(\text{CH}_3)_2\text{CH} \begin{array}{c} \diagup \text{CHO} \\ \diagdown \text{CH}_3 \end{array} \text{P} \begin{array}{c} \diagup \text{F} \\ \diagdown \text{O} \end{array}$
Prussic acid (forestit, vencentit in composition with trichloride of arsenic and stannic chloride)	Hydrogen cyanide and hydrocyanic acid	HCN
Cyanogen chloride (vitrite in composition with trichloride of arsenic)	Cyanogen chloride	ClCN
Adamsite	Dihydrophenarsazine-chloride	$\begin{array}{c} \text{C}_6\text{H}_4 \\ \diagup \text{HN} \diagdown \\ \text{C}_6\text{H}_4 \end{array}$

TABLE 1 (contd)

CHEMICAL AGENTS OF VARIOUS COUNTRIES

Agent	Chemical designation	Chemical formula
Diphenylchlorarsine (blark, blue cross agent)	Diphenylchlorarsine	$\begin{array}{c} \text{C}_6\text{H}_5 \\ \diagdown \\ \text{AsCl} \\ \diagup \\ \text{C}_6\text{H}_5 \end{array}$
Chloroacetophenone (grandid)	Chloroacetophenone	$\begin{array}{c} \text{CH}_2\text{Cl} \\ \diagup \\ \text{CO} \\ \diagdown \\ \text{C}_6\text{H}_5 \end{array}$
Phosgene (kollongit)	Acid chloride of carbonic acid	$\begin{array}{c} \text{Cl} \\ \diagup \\ \text{CO} \\ \diagdown \\ \text{Cl} \end{array}$
Diphosgene (syurpalit, superpalite, Perstoff- Ger., green cross agent)	Trichloromethyl- chlorocarbonate	$\begin{array}{c} \text{Cl} \\ \diagup \\ \text{CO} \\ \diagdown \\ \text{OCCl}_3 \end{array}$

B. Means of Employing Chemical Agents.

Chemical agents can be delivered to population centers by bombing planes, guided rockets, and, sometimes (if population centers are close to the front), conventional artillery and rockets that fire chemical shell.

In raids on towns and industrial targets the enemy may use chemical agents to disorganize operations of industrial installations, railroad junctions and stations, power stations, airports, etc; to disrupt or complicate (after an air raid) the rehabilitation work carried out by troops, units of the MPVO (local antiaircraft protection system), and the public; to inflict casualties among the personnel of MPVO systems in population centers and among the workers and employees of industrial and other targets; to demoralize people by contaminating their living quarters and compelling them to use gas masks or other means of protection for extended periods, and to contaminate warehouses, provisions, and other supplies, by causing their deterioration, or prolonging delay in their consumption.

In order to attain these objectives, the most suitable chemical agents to use would be those that contaminate the ground for a long time.

To inflict casualties, the enemy may mostly use agents that contaminate the air. Quick-acting agents such as Sarin and tabun aerosols, or prussic acid and cyanogen chloride, which have high toxicity, would be most suitable for this purpose. It is obvious that other agents such as diphosgene and phosgene could also be used, but they have considerably lower toxicities than Sarin and tabun, prussic acid, and cyanogen chloride, and will, therefore, only be used by the enemy when there is a shortage of more effective agents.

Chemical weapons will mostly be used in air attack in conjunction with other means of attack, such as high-explosive and fragmentation bombs, radioactive combat materials, etc.

The aircraft of capitalistic countries can now use chemical aerial bombs and can spray agents from a special spraying device.

1. Chemical Aerial Bombs.

Chemical aerial bombs (figure 1) can be filled with various agents and with combinations of agents. The weight of agent in a chemical aerial bomb comprises approximately 45% to 60% of its total weight. In addition to its chemical charge, a chemical aerial bomb has a detonating explosive for bursting the shell of the bomb and for converting the agent to a combat state. The bomb contains an impact- or aerial-burst fuze to activate the charge. The impact fuze detonates a bomb on impact against the ground, or other obstacle, such as a building. The aerial-burst fuze activates a bomb after it has been released from an aircraft, and causes its detonation at a predetermined distance from the ground.

Bombs are separated into two types, impact bombs and aerial-burst bombs, depending upon the type of fuze provided.

Bombs with impact fuzes are filled with persistent agents and are intended for contamination of the ground. Their total weight is usually small (they are of small caliber), but they can uniformly contaminate large sectors of a locality. The weight of these bombs varies between 50 kg and 250 kg (figure 2). A 250-kg chemical bomb, impact type, containing a persistent agent, can contaminate an area of approximately 2000 sq m with an average contamination density of 50 gm/sq m. Chemical bombs of the impact type that are intended for contamination of the ground can contain mustard, Sarin, or other persistent agents, or combinations of these agents.

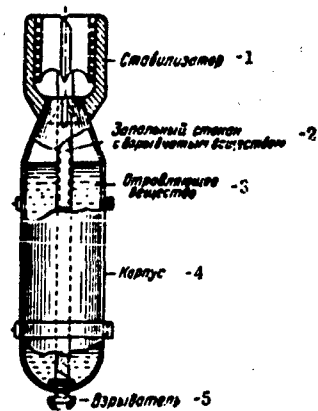


FIGURE 1

CHEMICAL AERIAL BOMB

1. Stabilizer, 2. Igniting socket with a detonating explosive, 3. Toxic chemical agent, 4. Shell, 5. Fuze



FIGURE 2

AMERICAN CHEMICAL AERIAL BOMB FILLED WITH MUSTARD

The sound of the explosion of such bombs is considerably weaker than that of high-explosive bombs, because the charge of explosive is small and is only needed for bursting the shell of the bomb and for spraying its contents. After the bomb detonates, drops and spray of the agent are dispersed in all directions, clouds of vapor and fog are formed, and as these rapidly disperse in the air, some of the fog settles on the ground. The place where the bomb exploded becomes the center of contamination produced by the drops and spray of agent. The largest amount of agent usually settles in the crater and in the adjoining area within a 5-m to 10-m radius. The walls of nearby buildings and fences would be splashed with the agent to the height of several meters. The center of contamination resembles a circle with an irregular contour. On windy days this center becomes enlarged and shaped like an ellipse on its leeward side. The torn shell of the bomb and, sometimes, its stabilizer are often found in the crater or nearby. Oily, dark drops, spray droplets, or residue left by the bomb can readily be noticed on walls of buildings, on roofs, on the ground, and on vegetation. After agents become absorbed, only a dark residue remains visible.

The odor of the agent can be picked up on the leeward side of, and at quite a long distance from, the crater. At night, a small flame may be visible during detonation.

A small amount of large debris is produced upon detonation of the bomb. The craters of exploded bombs are not deep, because chemical aerial bombs of the impact type only have a small charge of explosive. These bombs are also provided with very sensitive fuzes that cause immediate detonation of the bomb on contact with any obstacle. These fuses are called instantaneous-action fuses, in contrast to impact fuses that have delayed action.

The Air Forces of capitalistic countries are also armed with impact bombs for contamination of the air. These bombs are filled with nonpersistent or persistent agents. When the bombs detonate, the agents are converted to a cloudlike or vaporlike state. Bombs with nonpersistent agents have small charges of explosive, just sufficient to burst the shell of the bomb. Consequently, the detonation of such bombs sounds dull, and only a small amount of debris is produced. The bombs (figure 3) usually weigh several hundred kilograms (200 kg to 500 kg, or more), because they are intended for production of an immediate high concentration of agent over a large area upon explosion in the air. A phosgene-charged bomb weighs 250 kg, and develops a cloud up to 10 m in height; the concentration of agent is very high at the time of explosion. Dangerous concentrations are spread over considerable distances when contaminated air is carried by the wind, and when the concentrations reach stagnant places. Pools of liquid agent that fail to evaporate may linger in

craters. The evaporation of agents from bomb craters may be prolonged many minutes, or even several hours.

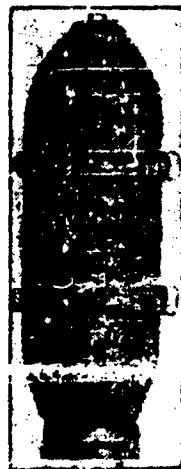


FIGURE 3

AMERICAN, 500-LB, AERIAL CHEMICAL BOMB, FILLED WITH PHOSGENE

(The agent in this bomb weighs up to 90 kg.)

Bombs containing persistent agents that are intended for the contamination of the air, have a comparatively larger charge of explosive (are supercharged). The charge is essential not only for bursting the shell of the bomb but also for converting its heavy liquid mass of agent into a mist. The sound of detonation of such bombs is considerably louder than that of bombs with nonpersistent agents, and the fragmentation effect is about 60% to 70% of that produced by fragmentation bombs of the same caliber.

It stands to reason that bombs for contamination of the air are dangerous only to that segment of the public that has no gas masks and that does not have the opportunity to seek safety in shelters and in other installations shielded from the contaminated air.

2. Chemical Aerial-Burst Bombs for Time Effect.

Airburst bombs for time effect contain only persistent liquid and viscous agents. There is little probability that chemical aerial-burst bombs for time effect would be filled with nonpersistent agents, such as prussic acid or phosgene, because nonpersistent agents would evaporate after detonation of these bombs and disperse in the air before reaching the ground.

In order to increase the length of contamination on the ground and to reduce losses resulting from evaporation and dispersion while the agents float in the air after an explosion, viscous agents would primarily be used in the summer as fillers for such bombs.

Time-effect bombs weigh from 100 kg to 1000 kg and more. After detonation at a height of 100 m above the ground, a 250-kg bomb will contaminate an area of approximately 3000 sq m; i.e., the agent will be disseminated over an area $2\frac{1}{2}$ times larger than that covered by an impact-action bomb. Consequently, time-effect bombs contaminate the ground for a considerably shorter time than impact bombs. It should also be noted that after detonation of time-effect bombs, a considerable amount of agent settles on the roofs of buildings and on tree tops, and this is less dangerous for the populace than are contaminated streets, back yards, and town squares.

The detonation of time-effect bombs is accompanied by a loud explosive sound. After a few seconds, rather dark clouds with torn and projecting foglike edges appear at the point of explosion. This is followed by the hardly noticeable settling of the drops and fog on streets, back yards, and roofs of buildings. The contamination of streets, yards, and roofs is more or less uniform. The explosion of time-effect bombs is accompanied by a flash, noticeable at night.

This type of bomb may be used during air raids on populated areas to contaminate the ground. The same would be true for impact-action bombs filled with persistent agents.

In addition to the various bombs already described, the Air Forces of capitalistic countries are equipped with small-caliber chemical fragmentation bombs. The usual weight of such bombs does not exceed 25 kg.

Chemical fragmentation bombs are standard fragmentation bombs that are filled with chemical agents and in which the explosive charge has been slightly decreased. A chemical fragmentation bomb hardly differs from a regular fragmentation bomb of the same caliber. Chemical fragmentation bombs contain solid agents that cause irritant effects. The agents are either

fused with the explosive, or placed in the bomb in a special container. After the bomb explodes, a cloud of toxic smoke is formed, which may be bluish-white (chloroacetophenone), yellowish (adamsite), or grayish (diphenylchlorarsine).

Chemical fragmentation bombs could probably be filled with agents that produce immediate systemic and highly toxic effects, such as Sarin. Upon detonation of such bombs, the basic mass of agent would become converted to an aerosol.

3. Airplane Spray Tanks.

Spray tanks (figure 4) are streamlined metal containers having various capacities (up to several hundred liters). The tanks are mounted under the wings of an aircraft. An airplane can carry two to four tanks depending upon its lifting power of the aircraft and the capacity of the individual tanks. The tanks are mostly filled with persistent, liquid agents that cause cutaneous-vesicant or systemic-toxic effects. Tanks may be filled in cold weather with a mixture of persistent and nonpersistent agents that can retain their contaminating power for several hours in open places. (Diphosgene, is regarded as a possible nonpersistent agent.) During summer, enemy aircraft may use spray tanks to spray solutions of some solid agents that will evaporate because of the heat and form concentrated vapors of irritant (solutions of chloroacetophenone).

The front part of a spray has a small opening for filling, and the outlet tube with its spray nozzle is in the rear. As the aircraft approaches its target, the outlet tube is opened by instruments controlled in the cockpit, and agents are released from the spray tanks. Regardless of the considerable weight of agent, the pressure of the head winds is used to assist in the operation of spray tanks (aerial "prompters"). Agents are released from spray tanks in 6 to 20 seconds, and the area sprayed becomes contaminated. The size of the contaminated area depends upon the altitude and velocity of the aircraft, spraying time, the amount of agent released, wind direction, and wind velocity. One average bomber, flying at an altitude of several decameters, can, with lateral wind, contaminate an area of 5 to 6 hectares with an average contamination density of 10 to 15 gm/sq m.

After the first few seconds of spraying, some dark and rapidly disappearing streaks can be noticed behind the rear of the airplane (figure 5). The agent then begins to settle like rain on the ground and on roofs of buildings. In a short time, small drops are visible on vegetation, surfaced streets, and roofs. Shortly after, only hardly perceptible dark traces of drops are left behind. The agent's odor may sometimes (e. g., when mustard is used) be picked up not only in the contaminated sector but also at a rather large distance from it (over 1 km), depending on the wind.

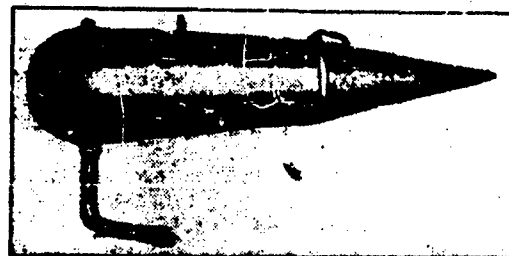


FIGURE 4

GERMAN AERIAL SPRAY TANK USED DURING WORLD WAR II

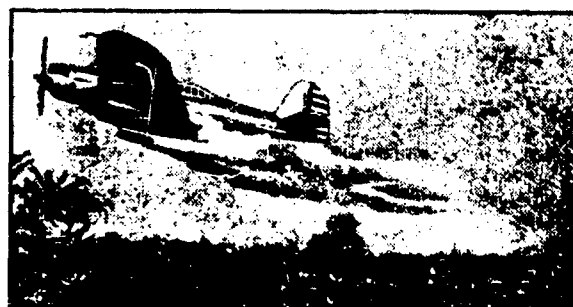


FIGURE 5

AMERICAN AERIAL SPRAY TANKS IN ACTION

Spraying from tanks attached to airplanes can be carried out only at low altitudes. Agents sprayed from higher altitudes have little effect because only a small amount reaches the ground, and even this amount could be dispersed by the wind to a great distance from the intended target. Such low-altitude operations are, however, hardly probable during air raids on populated areas at present, because of antiaircraft defenses. It can be assumed that aircraft attacking populated areas will not use fixed spray tanks but ones with set time controls that, when dropped on a target, will burst open and discharge agents at a predetermined distance from the ground. Such devices would most likely be used by a jet aircraft, because if jet planes attempted to spray agents from tanks mounted under the wings, the agents would encounter such strong head winds that only an insignificant amount of the agent would probably reach the ground.

In recent years, armies of certain capitalistic governments have given considerable attention to the use of agents delivered by guided missiles. A special complex apparatus for guiding such missiles is installed in the missile's body. The control station may be on the ground, in a plane, or on a ship.

A chemical agent can be placed in the warhead of the missile. Self-propelled missiles and long-range rockets would be used in attacking rear areas and installations. Modern self-propelled missiles are pilotless planes equipped with jet engines. Their speed ranges from 250 m/sec to twice, or three times, the speed of sound,¹ and they have ranges of from several hundred to several thousand kilometers. The altitude of flight varies from 10 km to 30 km, and higher. A self-propelled missile accomplishes a major part of its flight in a horizontal position, and then nosedives on its target and explodes. The flight of self-propelled missiles can be started from a point controlled on the ground, in a plane, or on a ship.

Long-range rockets, are streamlined self-propelled guided missiles equipped with an empennage. The rockets have liquid-fuel engines and are fired from their launching pads vertically. When they reach an altitude of 20 km to 30 km, the control system gradually leads the rocket to its target. As soon as the rocket has developed its predetermined velocity, the engine is shut off. The continuation of the rocket's flight depends on its inertia and, since the rocket is controlled by its guidance system, it is directed to fall to the ground at a 45° angle at a velocity of several kilometers per second and explode. Modern long-range rockets have average ranges of several thousand kilometers.

1. The speed of sound is 340 m/sec.

CHAPTER II

PROTECTION AGAINST CHEMICAL ATTACK .

A. Classification and Assignment of Means of Protection Against Chemical Attack.

Modern technology provides various means for protection against chemical agents.

Individual means, or means for personal protection, are those intended for protecting individuals. These means are gas masks and equipment for protecting the skin.

Collective means, or means for group protection, are intended for simultaneous protection of large groups of people. Shelters that possess special protective devices are considered to be the primary means of collective protection.

1. Protection of Food Supplies, Drinking Water, and Personal Belongings.

Decontamination methods are intended for decontaminating street surfaces, town squares, open places, exterior parts of buildings and inside quarters, conveyances, clothing, food commodities, and water contaminated by chemical agents.

These means are decontaminating agents, chemical solvents, local decontamination materials, insulating materials, and various decontamination vehicles, apparatuses, and equipment.

Modern individual and collective means of protection safeguard not only against toxic and radioactive agents but also against virulent microbes and poisons.

Thus, of greatest importance among all the means of protection are the individual and collective equipment; among the individual means masks assume first place.

B. Individual Protection.

1. Gas Masks.

Gas masks are intended for the protection of the respiratory organs, but they also protect the eyes and face.

All modern gas masks are divided (according to the principle of their protective action) into filter and isolating types. The former purify inhaled air contaminated by chemical agents, radioactive materials, microbes, and toxins; the latter protect the respiratory organs, the eyes, and the face against contaminated air.

Air inhaled through a gas mask filter passes through the gas mask canister, and radioactive materials and solid and liquid particles suspended in the air, which may be contaminated by pathogenic microbes and toxins, are neutralized or filtered.

Respiration through an isolating mask occurs at the expense of the supply of oxygen available in the gas mask. The mask isolates a person from the atmospheric oxygen and provides protection against all agents, radioactive substances, microbes, and toxins. Its isolating features are neither dependent upon the types of agents used nor upon their combat conditions and concentrations.

The most popular types of filter gas masks protect against all known agents, but the degree of protection is not the same and depends on various factors. A filter gas mask offers no protection against carbon monoxide, and an additional canister is used for protection.

Isolating gas masks are a more effective means of protection, and they have more advantages than filter gas masks. Isolating gas masks are less convenient to use than the filter gas masks, because they are cumbersome; their period of continuous use is shorter. They are expensive and complex to manufacture. A person is less willing to wear an isolating gas mask for a long time, and the training in its use is difficult. Isolating gas masks are, therefore, regarded as special purpose devices that are essentially for the work of special teams operating in a carbon monoxide atmosphere or in an area with very high concentration of chemical agents; they are also for use when the enemy employs unknown agents that are not easily absorbed by filter gas masks. In addition, these masks are also used when oxygen is lacking; i. e., during widespread conflagrations, or when carrying out rescue work and emergency technical work underground.

The basic means for furnishing full protection against agents is the filter gas mask. Being of simple construction and comfortable to wear, it is also light, comparatively inexpensive, and gives protection for many hours.

There are two models of filter gas masks that can be widely used by the public and by organizations of the MPVO; namely, the GF-4 and GP-4y.

a. Civilian Gas Masks.

The civilian gas mask (figure 6) consists of a canister, a facepiece, and a carrier. Each gas mask is equipped with a "crayon" that is used to protect the eyepieces against fogging.

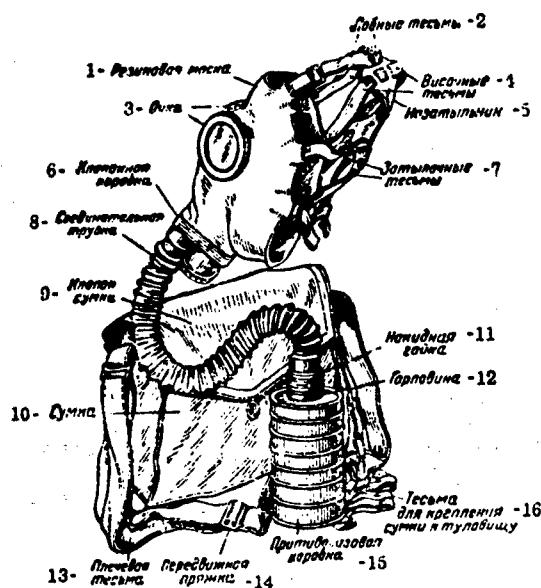


FIGURE 6

GP-4 CIVILIAN GAS MASK

1. Rubber facepiece, 2. Frontal straps, 3. Glasses, 4. Temporal straps, 5. Center pad, 6. Valve box, 7. Back (of head) straps, 8. Connecting hose, 9. Carrier flap, 10. Carrier, 11. Threaded cover, 12. Neck, 13. Shoulder strap, 14. Movable hook, 15. Gas mask canister, 16. Strap for fastening canister to the trunk

The GP-4 civilian gas mask protects the respiratory organs, eyes, and face against all known chemical agents, but, like the filter gas mask, it gives no protection against carbon monoxide.

The main part of the gas mask is the canister (figure 7), which filters out chemical agents, radioactive dust, and solid and liquid particles suspended in the air and contaminated by microbes and toxins. The canister is equipped with a special absorber and with a smoke filter. As contaminated air enters the lower entry opening of the canister, it passes through the canister body and smoke filter, where it is decontaminated of poisonous smoke and fog. The air then passes through a large straining cylinder filled with a special absorber, where the air is purified of vapor (gas) of agents and of vapor formed by poisonous particles of smoke and fog that became trapped by the smoke filter. Finally, the air passes through a small straining cylinder and through the canister's threaded neck.

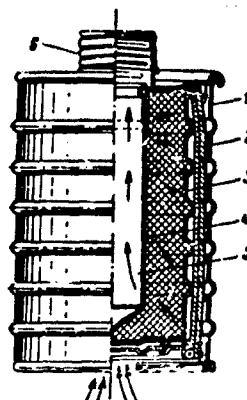


FIGURE 7

CANISTER OF GP-4 GAS MASK

1. Canister body, 2. Smoke filter, 3. Large straining cylinder with absorber, 4. Small straining cylinder, 5. Dust filter.
6. Threaded neck

Activated carbon is used as a base for the special absorber. It gives protection against the vapor (gas) of most agents and is by far the most important part of the canister's equipment in all modern filter gas masks. Activated carbon was recommended for use in gas masks for the first time in 1915 by Nikolai Dmitrievich Zelinski, one of the great Russian chemist-scholars and academicians.

The ability of activated carbon to absorb many vapors and gases occurs as the result of adsorption, which results in the condensation of gaseous molecules and vapors on the surface of solid substances, preventing the vapors and gases from becoming liquid. The larger the surface of the substance, the better it absorbs vapor and gas and, as we know, the magnitude of a substance's surface depends upon its porosity.

Wood charcoal has many pores, that are clogged with tar and other substances formed during the initial stages of combustion of carbon. These substances can be removed by a special carbon processing method. Thus, porosity increases considerably, and highly activated carbon can absorb vapor and gas. This special processing of carbon is called activation, and carbon processed in this manner is called activated carbon.

The activated carbon found in a gas mask canister looks like small grains.

The absorption of agents by activated carbon results not only from adsorption, but also from many other phenomena. Since a certain amount of moisture from atmospheric oxygen is always present in carbon, vapor of agents capable of disintegrating in water react chemically with the moisture present in carbon. This reaction results in the formation of new substances, mostly gaseous products, that in some measure are absorbed by the activated carbon.

Complex physical and chemical processes take place during the absorption of the vapors and gases by the activated carbon, but the most important process is the adsorption.

Notwithstanding its high absorptive ability, activated carbon does not satisfactorily neutralize the vapors of some agents. This disadvantage of activated carbon can be eliminated by providing (in a gas mask canister) special substances that can react chemically with vapors of certain agents that are poorly absorbed by activated carbon. Such agents are then converted to compounds harmless to humans, and the products developed by chemical interaction of the agents with moisture, which were not absorbed by the activated carbon, will also be rendered harmless. For example, when phosgene begins to react with moisture, it partly disintegrates and forms

carbon dioxide and hydrogen chloride. But hydrogen chloride, which possesses certain irritant and suffocative effects, is poorly absorbed by activated carbon. Hence, when special substances are placed in a canister, they are also intended to provide protection against hydrogen chloride.

When special substances are used in a canister, they are either placed on the grains of the activated carbon (saturated with solutions obtained from subsequent desiccation), or placed as a separate layer on the absorber (chemical absorber)

Special substances are placed on grains of activated carbon in civilian gas masks. Activated carbon does not absorb agents in a smokelike or foglike state well, and, therefore, a special filter is placed in the gas mask canister.

The smoke filter is made of fibrous materials; e. g., pulp-board processed in a special way. The interstices of fibers of a smoke filter usually resemble a pattern of winding, long, and narrow paths, through which particles of fog and smoke pass when air is inhaled. As particles of smoke and fog inevitably come in contact with the surfaces of fibers in a filter, they settle and remain there. The settling is facilitated by the forces of attraction and electrification that are present in filter materials, and that are effective during passage of contaminated air as it creates friction against the materials.

Particles of smoke and fog absorbed by a smoke filter evaporate and liberate agent vapor. For this reason, the smoke filter in a gas mask canister is positioned to enable contaminated air to pass through the filter first and then through the activated carbon. Such positioning of the filter facilitates absorption by the activated carbon of agents that are liberated by fog and smoke in a smoke filter.

Smoke filters also absorb foglike and smokelike radioactive substances and radioactive dust, and solid and liquid particles contaminated by microbes and toxins.

Having examined the mechanism of absorption of chemical agents in a gas mask canister, it can be seen that the protective potential of a filter gas mask depends upon many factors. It cannot be said that a filter gas mask protects against agents for a certain, definite time, but we know that civilian gas masks give protection for several hours of constant operation against agents employed in concentrations that can be expected during combat. The duration of protection against radioactive substances is limited only by the time within which a gradual accumulation of gamma- and beta-gamma

radioactive substances occurs, and their radiation (gamma-rays) through the walls of the canister renders the use of a gas mask too dangerous for the individual. The degree of danger present in a gas mask canister with relation to gamma radiation is tested with special (dosimetric) instruments. Alpha- or beta-radioactive particles, absorbed by a gas mask, are fully retarded by the canister and by its walls. Therefore, the protection potential of a gas mask against alpha- or beta-radioactive substances is, practically speaking, not dependent on the quantity of radioactive dust that enters the canister of a gas mask.

The cover of the canister is equipped with a threaded neck that connects the canister to the gas mask tube. If protection against carbon monoxide is needed, the so-called hopcalite cartridge (a gas mask filter) is inserted between the canister and the connecting tube, or directly to the connecting tube.¹

The hopcalite cartridge (figure 8) resembles a cylindrical canister and is charged with hopcalite and with a drying agent. Hopcalite is a mixture of the oxides of several metals. In the absence of hopcalite, carbon monoxide becomes oxidized into carbon dioxide at the expense of atmospheric oxygen. The chemical composition of hopcalite does not change, however. Since atmospheric humidity rapidly deprives hopcalite of its protective characteristics, the layer of hopcalite is protected against moisture at the top and at the bottom with a layer of drying agent; i. e., with a substance that absorbs moisture. Calcium chloride and silica gel can be used as drying agents.

The oxidation of carbon monoxide is accompanied by a considerable liberation of heat. Consequently, a hopcalite cartridge heats up considerably in a very short time and the inhaled air becomes heated. A hopcalite cartridge is considered used after 80 to 90 minutes of operation, or after its weight has increased above 40 gm. The protective effect of hopcalite decreases as the air temperature approaches 0°C; it becomes ineffective when the temperature reaches -10°C to -15°C.

The facepiece of a civilian gas mask consists of a rubber mask with eyepieces, a webbing system, a valve box, and a connecting tube.

1. The attachment of a hopcalite cartridge directly to the connecting tube is permissible only when chemical, atomic, or bacteriological weapons are not used.

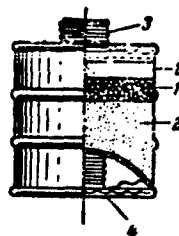


FIGURE 8

HOPCALITE CARTRIDGE

1. Hopcalite, 2. Drying agent, 3. Outer elbow nozzle, 4. Threaded opening

The facepiece is used to direct purified air from the canister to the respiratory organs. At the same time, it protects the eyes and the face against chemical agents, radioactive fallout, and microbes; it can also lessen the effects of flash radiation from an atomic explosion, which is harmful to the face and to the eyes.

Facepieces are manufactured in three sizes and the sizes are marked by number on the chin part of every mask. It is very important to select a gas mask that fits properly. If the facepiece is too small, it compresses the blood vessels in the head and neck, and exerts pressure upon the larynx and lower part of the jaw, making it difficult to wear the gas mask for an extended time. If the facepiece is too large, the contaminated air may bypass the canister and penetrate the gas mask. In addition, it is difficult to breathe and inconvenient to see with a large gas mask, because the eyepieces tend to move back and forth with each inhalation and exhalation.

In order to select the right size gas mask, it is necessary measure (with a calipers, millimeter ruler, or some other way) the distance between the point of the deepest recess transfer (saddle) and the lowest point on the chin or the central line of the face (nasion-menton).

If the above distance measures from 99 mm to 109 mm, the corresponding gas mask is size one; 109 mm to 119 mm corresponds to a size-two gas mask; and 119 mm and greater corresponds to a size-three gas mask.

The gas mask is tightened on the head with a head pad and webbing. (The two forehead harness straps are nonstretching; the four straps for depth and the two for the back of the head, stretch.)

The valve box has two openings for inhalation and exhalation. The rubber tube connecting the gas mask canister to the facepiece is attached to the inhale opening with the canister branched piece. The rubber disk above the inhale opening, fastened with a pin, is called the inlet valve.

The upper exhale valve is connected to the exhale opening of the valve box. A short tubular branched piece extends from the exhale opening. The lower exhale valve is a small metallic shield with openings to protect the valve against mechanical damage and against falling out of the valve box at the bottom.

The upper exhale valve consists of two round sheets of rubber (leaves) that are connected at four points to small rubber projections (clamps) found on each leaf. The upper leaf of the valve, with a round opening in the center, is provided with a flanged edge that helps the upper exhale valve to remain fastened in the valve box. The lower exhale valve resembles a rubber disk on a pin.

The way in which the valves work and their purpose are described in the following. The inhale valve is influenced by the pressure of the outside air during inhalation and rises slightly on its pin and allows the air purified in the canister to pass under the facepiece. Upon inhaling, air pressure under the facepiece decreases and this causes the lower solid leaf of the upper exhale valve to tighten against the upper leaf. (The valve closes and prevents contaminated air from the outside from getting under the facepiece through the exhale opening in the valve box.) At the same time, the lower exhale valve, functioned by a decrease in pressure under the facepiece, closes and assists the upper exhale valve in the performance of its function.

Two exhale valves are required because exhale valves of any design permit a very small amount of contaminated outside air to pass through during inhalation. Prior to the appearance of highly toxic agents of the Sarin type this was of no practical importance, but even a small amount of Sarin, or similar agent, seeping under the facepiece through the exhale valve can be dangerous. The second exhale valve was introduced to reduce the seepage of contaminated air during inhalation.

The upper (two leaf) exhale valve is the main valve and the lower (one leaf) one is the auxiliary.

During exhalation the inhale valve closes under the influence of atmospheric pressure and does not admit exhaled air to the mask through the inhale opening to the connecting hose or through the gas mask canister. The exhaled air passes through the opening of the upper leaf in the upper exhale valve, and then, because of the pressure exerted upon the lower leaf of the same valve, the air pulls the lower leaf down and passes through clearances between both leaves of the valve. Having reached the lower exhale valve, the exhaled air shifts the valve slightly on the pin to which the valve is fastened and then the air escapes outside.

Thus, during exhalation the mission of the inhale valve is to block the entry of the exhaled air to the gas mask canister and to guide this air out through the exhale valves. During inhalation the exhale valves prevent direct entry of contaminated air under the facepiece and compel the air to pass through the gas mask canister, before it enters the facepiece.

The connecting (corrugated) hose is made of rubber. Lateral folds (crimps) improve flexibility of the hose and prevent closing or coiling of the hose as a result of bending. The upper end of the hose is hermetically fastened to the socket of the valve box. The connection to the elbow nozzle of the gas mask canister closes by turning a threaded nut, which is provided with a nipple and which is located at the lower end of the hose. Connecting hoses can be short or long. The gas masks equipped with a short hose can be brought to a ready position by being shifted from the side toward the chest. A long hose eliminates the need for this additional move and allows the gas mask carrier to be carried on one side, which is more comfortable than having the gas mask and its carrier and canister on the chest. The carrier is used for carrying and for protecting the gas mask.

During the explosion of atomic and bacteriological weapons, the fabric of the carrier can also serve as a preliminary filter for the air entering the gas mask canister, because the fabric can stop the larger particles of dust contaminated by radioactive substances or by disease-producing microbes and toxins. The carrier is made of a durable fabric and has two compartments: one for the gas mask canister and the other for the facepiece. There are two wooden cleats fastened to the bottom of the canister compartment so that the gas mask canister does not rest on the bottom of the carrier; these cleats allow a free access of air to the canister opening.

The compartment for the facepiece contains the so-called soapy crayon, which is placed in a special pocket or directly on the bottom; the crayon is used to protect the eyepieces against fogging.

Attached to the carrier are suspension straps with movable buckles. If a person who has the carrier resting on his body intends to bring the carrier to a ready position, a cloth tape, a string with a metal D-ring, or a string with a cloth eye, which is sewn on the side of the carrier facing the body trunk, is used.

The carrier is covered with a flap that closes tightly with a strap and buckle or with buttons and buttonholes.

The civilian gas mask GP-4y (the letter y denotes improved) differs from the GP-4 gas mask by having a greatly improved special absorber and by having a smoke filter. These features increase the protective capabilities of the GP-4y gas mask. The connecting hose in this gas mask is of the long type.

b. Care of Filter Gas Masks.

Gas masks require very careful handling. Even insignificant malfunctions, appearing for the first time, may result in poisoning if the gas mask is used in contaminated air.

The gas masks individually assigned must be stored in the assembled state and in a hanging position in the carrier (carrier hanging by its strap). If they are stored on shelves, one should see that the gas mask canister stands with its bottom down. Clothing should not be left hanging on top of a gas mask, nor should any other objects be placed on top of a gas mask.

Gas masks in collective storage are placed in cabinets with shelves or with recesses, in boxes, or on racks. These gas masks are usually stored disassembled.

The storage place for a gas mask should be no closer than 1 m to a hot stove, or pipes and radiators of central heating systems. Prolonged heating damages the rubber of the facepiece and causes aging. Aging of rubber reduces its elasticity and causes friability and cracks after bending that will allow easy tearing of the rubber.

Gas masks should not be stored in a low-temperature environment, which could cause damage to the rubber parts. Sharp deviations in temperature also have a harmful effect upon absorbers and decrease their protective capacity. Gas masks should be stored in temperature between 5°C and 15°C.

Humidity has a very harmful effect upon a gas mask. When a gas mask is stored in a damp place, the canister casing and other metal parts rust, and rubber loses its elasticity. The protective capacity of the filters decreases and breathing difficulties may develop. Gas masks should, therefore, not be stored near water pipes, sinks, wash basins, on window sills, or in other damp places.

If a gas mask has been exposed to rain, it should be taken out of its carrier at the first opportunity, carefully wiped off, and left to dry. A gas mask should be put back into its carrier only when completely dry.

After each use, the gas mask should be carefully wiped off on the inside, including the valve box.

Gas masks should not be stored near highly volatile liquids, such as benzene or kerosene, if the liquids are not in a hermetically sealed container. Absorption of the vapors of these liquids causes a gas mask to lose its protective capacity. Gas masks should not be stored near decontaminating substances that liberate chlorine gas.

When handling a gas mask, it must be protected against knocks, sharp jolts, and heavy shaking, because this can cause harmful crumbling or shifting of the absorber, impair the sealing of the canister and eyepieces, cause dents in the canister container or in the valve box, and damage or cause malfunctioning of the valves.

Foreign objects must never be put inside a gas mask, because they may cause damage.

The valves should not be disturbed or removed without a specific reason. Particular protection against damage or obstruction should be given to the respiratory valves. A gas mask must not be used as a cushion or a pillow.

If the rubber of a gas mask is exposed to severe frosts, it hardens and becomes brittle. This circumstance may cause damage to the gas mask when it is stretched in the course of being put on. To prevent this, it is recommended that the gas mask be taken out of the carrier and warmed up on the chest under the outer garment prior to assuming ready position.

2. KIP-5 Isolating Oxygen Apparatus.

The KIP-5 isolating oxygen apparatus (figure 9) consists of the following main parts: a cylinder with compressed oxygen, a mechanism for the

continuous supply of oxygen, a respiratory bag with a relief valve, a regenerating cartridge, a lower junction box, a facepiece, and a housing. The usual weight of the apparatus is 9 kg.



FIGURE 9

GENERAL VIEW OF THE KIP-5 ISOLATING OXYGEN APPARATUS

(Without hinged container casing)

1. Facepiece, 2. Valve box, 3. Respiratory bag,
4. Mechanism for continuous supply of oxygen,
5. Relief valve, 6. Lower junction box,
7. Regenerating cartridge, 8. Cylinder with oxygen,
9. Bottom of housing

Respiration using the KIP-5 is carried out in the following manner (figure 10). During inhalation, oxygen passes from the respiratory bag through the inhalation connecting hose, then under the facepiece and to the respiratory organs. Some of the oxygen (approximately 5%) is absorbed in the lungs. The exhaled air, which has a decreased oxygen content and a 4% to 4.5% admixture of carbon dioxide, passes through the exhale valve and through the exhale connecting hose to the regenerating cartridge. The cartridge purifies the mixture of carbon dioxide and the air then passes through the lower junction box to the respiratory bag. In this bag the air is again replenished to the standard level of oxygen content as the gas flows steadily from the cylinder to the respiratory bag. The same operational cycle is repeated with each subsequent inhalation and exhalation.

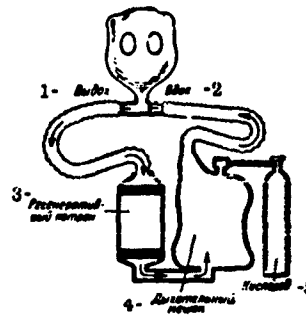


FIGURE 16

BREATHING THROUGH THE KIP-5 APPARATUS

1. Exhalation, 2. Inhalation, 3. Regen-
- erating cartridge, 4. Respiratory bag,
5. Oxygen

The oxygen cylinder, which has a 0.7-liter capacity, contains 105 liters of oxygen in a highly concentrated form (the pressure in the cylinder amounts to about 150 atmospheres). This supply of oxygen is sufficient for 45 to 60 minutes of breathing. If the cylinder is used up, it can be replaced by another cylinder without interruption. This requires that the facepiece be kept on; the regenerating cartridge should not, however, be replaced in the same way. Thus, the duration of protective effects of the KIP-5 apparatus is measured by the duration of the effectiveness of its regenerating cartridge, which is approximately 2 hours.

The oxygen cylinder is equipped with a valve for controlling the supply of oxygen to the respiratory bag and for shutting off the flow.

The supply mechanism for the oxygen is for reducing the pressure of the oxygen that passes from the cylinder to the respiratory bag and supply oxygen in sufficient amounts to the respiratory bag. The mechanism consists of a reducer, a bypass, a pulmonary automatic device, and a finimeter (German technical-commercial term). The mechanism is connected to the

oxygen cylinder by a threaded nut, and its branched pipe is attached to the respiratory bag.

The reducer is for reducing the pressure of the oxygen as it passes from the cylinder to the respiratory bag, and to supply oxygen uniformly (1, 1.5, or 2 liters per minute) to the respiratory bag, according to the needs of the individual. Control of the oxygen supply is effected by turning the head of the reducer and by setting its indicator on the figures 1, 1.5, or 2.

The bypass is essential for rapid inflation of the respiratory bag with oxygen if the supply of the reducer is insufficient, or if the pulmonary automatic device does not operate properly. The moment the bypass button is pressed, oxygen starts flowing from the cylinder directly to the respiratory bag at the lowest velocity of 40 l/min.

The pulmonary automatic device is designed for automatic supply of oxygen to the respiratory bag during deep inhalations, when the amount of oxygen supplied by reducer is insufficient for the requirements of the lungs. The automatic device in the respiratory bag is connected to the reducer. The velocity of the flow of oxygen through the pulmonary automatic device is never below 40 l/min when the reducer is set at an inflow of 1 l/min.

The finimeter is used to determine the amount of oxygen pressure in a cylinder. The finimeter dial has 25 graduations for figures running through 50 atmospheres. (Figures can run up to 150 atmospheres.)

The respiratory bag (5-liter capacity) is made of thin rubber and serves as a container for an amount of oxygen need by an adult for normal breathing.

The relief valve is set in the left side wall of the bag; its function is to release automatically all superfluous oxygen. The upper part of the respiratory bag is connected to the oxygen supply mechanism and to the inhale connecting tube, while the lower part is connected to the lower junction box.

The regenerative cartridge is for absorption of the carbon dioxide present in the mixture of exhaled gases. The cartridge resembles a tin box and is filled with a chemical lime absorber. The upper part of the cartridge is connected to the exhale connecting hose, but the lower part is connected to the junction box, from which the gas mixture, purified in the cartridge, flows to the respiratory bag.

The lower junction box is designed to connect the regenerative cartridge with the respiratory bag. The box also cools the exhaled mixture of gases passing through it and intercepts moisture flowing out of the regenerative cartridge.

The facepiece isolates the respiratory organs, eyes, and face from the surrounding environment and connects the respiratory organs to the respiratory bag and with the regenerative cartridge. The facepiece consists of a mask (helmet), valve box with the inhale and exhale valves, and two corrugated connective hoses (the inhale and the exhale hoses).

All parts can be fastened to the casing, which also protects the respiratory bag against mechanical damages. Both parts of the apparatus, i. e., the respiratory bag and regenerative cartridge, are covered with head flaps.

A shoulder and waist strap, both with buckles, are attached to the casing and serve as a support for carrying the apparatus on the body.

The apparatus is also equipped with a tool bag, which contains tools needed for the operation of the apparatus and some spare parts. The facepiece (helmet), which cannot be disconnected from the hoses, can also be packed in the tool bag.

The apparatus is supported by a shoulder strap when carried (figure 11), and the tool bag is supported by a waist strap.



FIGURE 11

KIP APPARATUS IN COMBAT POSITION

There are also other types of oxygen-isolating apparatuses available, in which the oxygen is not in a gaseous form, but in a chemically combined form, in special briquets. Gaseous oxygen is generated as a result of chemical reaction between the briquets and the carbon dioxide exhaled by a person using the isolating apparatus.

3. Means for Protecting the Skin.

For individual protection against agents that contaminate the skin and attack internal organs through the skin, special means (in addition to a gas mask) are needed to protect the skin.

Only such means for protecting the skin that can be used most often to protect the public and personnel of the MPVO will be discussed. These include protective footwear, gloves, aprons, clothing, as well as impregnated underwear and impregnated clothing.

a. Protective Footwear.

Protective footwear (figure 12) are used to protect the feet against liquid agents. These footwear also protect the feet against radioactive dust, liquid and powdery radioactive combat substances, and liquid substances or dust contaminated by microbes and toxins.

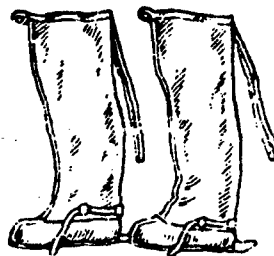


FIGURE 12

PROTECTIVE FOOTWEAR

The protective footwear, illustrated, are made of rubberized or oil-impregnated material; canvas is used to reinforce the soles and the uppers. The upper parts of the protective footwear are provided with straps for tying.

them around the legs; straps in the lower part are for tightening the footwear around the feet. A little tongue is sewn to the sole at its counter to permit removal of contaminated footwear without using the hands. The protective footwear are slipped over conventional shoes.

Protective footwear come in three sizes. The first is for shoe sizes 37 to 39, the second for shoe sizes 40 to 42, and the third for shoe sizes 43 and larger. The size is indicated by a number on the outside upper part of the footwear. Such footwear weighs 600 gm to 800 gm.

b. Protective Gloves.

Gloves are made of rubber or rubberized material. They are fitted for only three fingers, or for all the fingers. A pair of gloves weighs approximately 350 gm.

c. Protective Aprons.

These aprons are used during decontamination of various contaminated objects as well as for work at sanitary processing stations. The aprons are made of rubberized material and are used with protective footwear and rubber gloves.

The protective apron is cut like the usual work apron used for protecting the chest, abdomen, and hips. The apron weighs approximately 400 gm.

d. Protective Clothing.

Protective clothing is designed to protect the entire body and is usually used by personnel of newly activated units and by small units of the MPVO for work in contaminated areas. A set of protective clothing (figure 13) consists of coveralls, high rubber boots, rubber gloves, and a helmet liner. A set may include one protective jacket and a pair of trousers instead of coveralls. Protective clothing is intended for protection of the skin against agents in any combat form, against contacts of the skin and normal clothing with radioactive substances, and finally as protection against powdery or liquid carriers of germs and toxins.

Protective coveralls are made of rubberized material. The coveralls consist of trousers, a jacket, and a hood, which are sewn together and form one unit. The upper part of the hood can be tightened and the lower part is provided with a collar, belt, and clasps. A longitudinal seam runs down from the collar. A broad chest flap is fastened to the coveralls along

the hem at the left side, and is intended for covering part of the neck, the chest, and stomach area. The flap has five clasps. An additional flap is provided as protection for the neck. It is sewn to the chest flap of the coveralls and its skirt is snugly tightened at the throat. The sleeves, containing inside cuffs, have an additional extended collar to cover both hands up to the fingers. A strap tightens each cuff above the wrist. When rubber gloves are put on and their cuffs are pulled above the wrists, the hermetic sealing of the coveralls is completed.

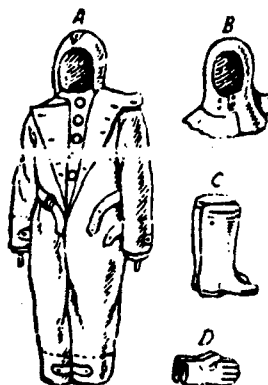


FIGURE 13

PROTECTIVE CLOTHING

- A. Coveralls, B. Helmet liner, C. Boots,
D. Gloves

The trousers also have cuffs and straps for tightening at the bottom. Before the high rubber boots are put on, the cuffs should be pulled down to cover the shins, and then tightened with the straps (figure 14).

The coveralls are tightened with a belt at the waist line.

Rubberized coveralls retain their elasticity even in severe frosts. The coveralls weigh approximately 3.5 kg.



FIGURE 14

PROTECTIVE CLOTHING IN COMBAT READINESS

Protective coveralls are made in three sizes. The first size fits persons up to 165 cm tall; the second, persons from 165 cm to 172 cm tall; and the third, persons taller than 172 cm. The size of the coveralls is indicated by a number printed on the outer edge of the chest flap.

e. Rubber Boots.

Boots are made according to models used by various branches of industry, and by construction workers. High boots are made in all sizes, from 41 to 46 inclusive. The size of the boots is shown on their soles. One pair of boots weighs approximately 2 kg.

f. Helmet Liner.

The helmet liner is the same size for all sets of protective

clothing. It is used to eliminate all nonhermetic fittings under the chin and along the face line of the hooded part of the coveralls. The helmet liner has a neck flap and a drawstring for tightening. It is made of cotton fabric impregnated with substances to absorb vapors of persistent agents.

g. Protective Jacket and Trousers.

The jacket and trousers are made of rubberized material. The jacket is made similar to the upper part of the coveralls. The top part of the trousers has two shoulder straps. An additional strap on the left side of the top part of the trousers is used to tighten the trousers at the waist line. The bottom part of the trousers has cuffs and straps sewn on.

The jacket and trousers are made in three sizes similar to those of the coveralls. The size of the jacket is marked on its chest flap; the size of the trousers can be found on the outside, close to the side fold of the upper part. Jacket and trousers weigh 3.6 kg. As a rule, when the prevailing temperature is 10°C or above, protective clothing, of both types, is worn only over underwear. When the temperature ranges between 0°C and 10°C this clothing is worn over normal summer suits, military summer uniforms, or cotton overalls used for work. At temperatures between 0°C and -10°C, the protective clothing is worn over woolen suits, garments made of warm cloth, ski suits, etc. When temperatures range below -10°C, the protective clothing is worn over quilted jackets and trousers that are worn over warm clothes, ski suits, etc.

High rubber boots are worn over woolen socks, or over the protective footwear at temperatures below 0°C, and rubber gloves are worn over woolen gloves.

When protective clothing is used, the outside air does not penetrate the coveralls, and the natural radiation of heat by the human body becomes disturbed. In order to avoid overheating and to prevent hazards to health (including heat stroke), time limits have been established for continuous wear of protective clothing. When the air is 30°C and above, the time limit is 15 to 20 minutes; at 25°C to 29°C, the time limit is 30 minutes; at 20°C to 24°C, the time limit is 40 to 50 minutes; at 15°C to 19°C, the time limit is 90 minutes to 2 hours; and below 15°C, the time limit is up to 3 hours or longer. A person can work continuously for 3 to 4 hours in protective clothing during cold weather. In the summer, with a mild wind blowing or in still air, all the above time limits for continuous usage are maximum limits. At work in the shade, in wind, or during cloudy weather, physically healthy people, who have undergone special training, can, if necessary, use protective clothing 1 1/2 to 2 times longer. In order to enable a person to carry out continuous (up to 6 hours)

work requiring great physical effort, shielding coveralls made of a cotton fabric (moleskin) are recommended. The shielding coveralls are donned over the protective clothing and are soaked with water every 90 minutes to 2 hours.

h. Impregnated Underwear and Clothing.

In order to protect the entire body against vapors of agents that attack the skin or through the skin, impregnated underwear and clothing (i. e., impregnated with special compounds) should be used. Although protective coveralls and protective jackets are airtight, the impregnated underwear and clothing pass (filter) the air and decontaminate it at the same time. The protection afforded by impregnated underwear and clothing is based on the chemical reaction of the composition of a given impregnator with the agent. The impregnated fabrics protect against vapor of agents. A protective filtering set (ZTK-50), which is part of the equipment of newly activated and small units of the MPVO, includes impregnated underclothes, a pullover tunic, trousers, cotton coveralls, and a helmet liner. The set protects against the vapor of agents for many hours and temporarily protects against contamination by persistent agents.

i. Care and Storage of Skin Protection Equipment.

All equipment for skin protection should be protected from physical damage.

Protective footwear and aprons are best stored by hanging on horizontal bars or ropes.

Sets of protective clothing should be stored in crates at depots. Sets of rubber boots and gloves, protective coveralls or jackets and trousers, and helmet liners should be stored with newly activated and small units of the MPVO; i. e., on shelves in bundles tied together by belts from coveralls or jackets.

If the protective clothing becomes wet, damp, or dirty, it should be wiped with a rag and left to dry before being stored. Contaminated clothing should be decontaminated before being returned to storage.

Protective clothing can be damaged if stored under improper conditions. The clothing may become mildewed, and excessive dryness can also be harmful. The most suitable storage condition is an atmosphere having a relative humidity between 60% and 65%. The room where protective clothing is stored should have good ventilation. The best suitable temperature for storage is between 12°C and 16°C.

All equipment for skin protection must be protected during storage against direct sunshine.

4. Emergency Means for Skin Protection.

During evacuation of contaminated areas, the public must use gas masks and other means of protection against toxic and radioactive substances and disease-producing germs and toxins. Civilians, who have no equipment for skin protection (authorized allowances of supply) can use other emergency items. Ordinary rubber overshoes, rubber shoes, or shoelets, can be used to protect the feet against liquid agents that cause blisters within 15 minutes. The exposed parts of the feet can be protected with oil cloth or with some other thick fabric (preferably wrapped two or three times, with padded newspaper folded in between). If tied to the soles of footgear, small planks of wood or plywood can give some protection to the feet. After crossing a contaminated sector, the emergency equipment used to protect the feet should be taken off immediately; shoes should be rubbed with bleaching powder or with some other decontaminating agent and then washed with water.

The wrists and hands should be covered with thick gloves or mittens when crossing contaminated areas.

Ordinary cloaks and raincoats made of rubberized fabrics, oil cloth (or oil skins), or fabrics coated with vinyl chloride, leather coats, coats made of thick cloth, or drapes, do not allow liquid agents or radioactive particles to penetrate for 5 to 10 minutes. An overcoat made of thin cloth with a lining prevents the penetration of liquid agents or radioactive particles for 1 to 2 minutes. Quilted and fur-lined winter clothing give much better protection than all of the other types of clothing described above.

In order to protect the skin against vapors of vesicant agents or against the effects of radioactive substances or disease-producing germs and toxins, it is necessary to button clothing tightly and to tie the ends of sleeves and trousers. It is also helpful to lift the coattails of the outer garment and tie them under the petticoat with a scarf fastened around the legs. Children up to 5 or 6 years old must be evacuated from contaminated areas dressed in quilted or thick woolen clothes or wrapped in baize blankets.

It should be noted that outer garments used as emergency equipment for skin protection can become the source of contamination and may lose their effectiveness after several minutes. This outer clothing should be taken off immediately upon leaving a contaminated area. If there is any suspicion that the clothing might have become contaminated, the person should apply for

disinfection, and the clothing should be sent to a decontamination point.

C. Collective Protection Against Chemical Agents.

The collective means for protection are intended to provide protection against chemical agents, radioactive substances, and disease-producing germs and toxins to a large group of people. Basic among these means are shelters, which are specially equipped to protect against chemical agents. In addition to protection against chemical agents, radioactive agents, and disease-producing germs, shelters also offer protection against blast waves from atomic explosions and demolition bombs, against radiation flash and penetrating radiation (after explosion of atomic bombs), against incendiary bombs and fires, and against bomb fragments and debris from damaged or crumbling buildings. Other places of concealment, although lacking the equipment for protection, but which offer some measure of protection against weapons used in air attacks, are also considered as affording collective protection.

Only special features of equipment in shelters as they protect against chemical agents will be discussed here.

The basic features for protection against chemical agents are gas-proofing devices and filtered ventilation.

Gasproofing of shelters is the conditioning of the inside premises by isolating them from the surrounding air. This is attained by the construction of gasproof walls, overhead covers, intake air locks, and hermetically tight doors and shutters.

The entry door and the door leading from the air locks to the inside premises are usually made of steel.

All doors are snugly fitted to the doorframes, and, in addition, a strip of rubber is attached to the edges of the doors. Sealing of the doors is secured with a special pressure device (sliding wedge breechlock).

All possible leaks in the construction of overhead covers, in places where water pipes enter the walls, or in sewerage and heating systems and where telephone, electrical, and other wires enter the walls must be eliminated by various methods.

Loose connections in heating and hot water pipes can be sealed with a nondrying plastic cement, and the pipes can be protected with heat-insulating materials in places where they pass through walls or through overhead covers. All open spots around cold water pipes can be blocked by applying calking.

to tarred fiber packing and then by sealing with mortar. Wires should be enclosed in galvanized or porcelain tubes where they pass through walls. All tubes installed in walls or in overhead covers should rest on mortar bases. As soon as the installation of wires is completed, the openings in the galvanized or porcelain tubes should be cemented on both sides of the walls or overhead covers with a special composition.

Ventilation ports can be hermetically closed with shutters, if necessary.

Filtered ventilation of shelters and places of concealment has two purposes. First, it should secure the supply of the necessary amount of decontaminated air to the shelter; i. e., sufficient air for people to remain in the shelters without gas masks for a long time. Second, the filtered air in shelters should be kept at a higher pressure than outside.¹ This will prevent the penetration of contaminated air into the shelter.

Filtered ventilation in the shelters is maintained with the aid of suitable equipment.

The filtered ventilation system (figure 15) consists of the following: absorbing filter, dust filter, ventilator, air intake ducts, air supply pipes, and hermetic valves.

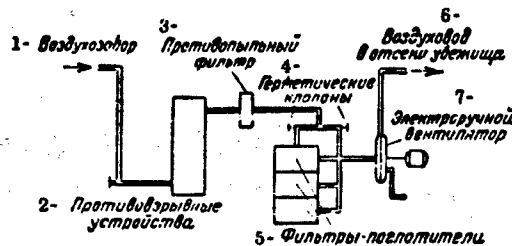


FIGURE 15

LAYOUT OF INSTALLED FILTERED VENTILATION SYSTEM

1. Air intake, 2. Blastproof construction, 3. Dust filter, 4. Hermetic valves, 5. Absorbing filters, 6. Air supply pipe to a shelter room, 7. Hand-operated electric ventilator

1. The difference in pressure between the inside and the outside air is called a "brace."

The absorbing filter is used to purify outside air contaminated by chemical agents and disease-producing germs and toxins. The air supplied to a shelter is purified of dust (including radioactive dust) by a dust filter.

The absorbing filter resembles a metal cylinder, which is filled with absorbers, and contains a smoke filter (figure 16).

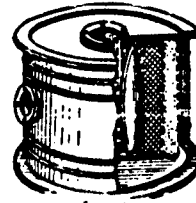


FIGURE 16

ABSORBING FILTER

The most common absorbing filters purify up to 100 cu m of contaminated air in 1 hour. Depending upon its capacity, a shelter can be equipped with one or with several absorbing filters forming a column, as is shown in figure 17.

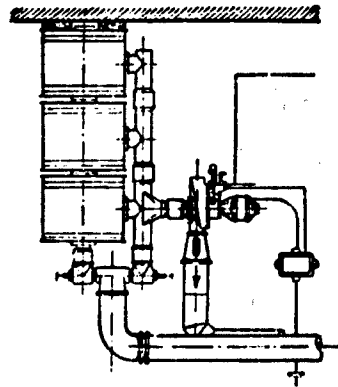


FIGURE 17

FILTERED VENTILATION ASSEMBLY WITH COLUMN OF THREE ABSORBING FILTERS

The column (or a separate filter absorber) is connected to the ventilator.

The ventilator supplies outside air to the shelter.

Ventilators are started by electric motors, although some types of ventilators are hand driven.

The outside air first flows to the filters via the air intake ducts and pipes, and then to a ventilator, before it is distributed inside the shelter. The air intake ducts are protected by blastproof reinforcements that are used to reduce the pressure of a blast wave that could penetrate the ducts at the time of the explosion of atomic or demolition bombs or guided missiles. Since the inside area of a shelter is also protected against demolition, people in shelters will not feel the effects of a blast wave. All pipes supplying air are outfitted with hermetic valves. As the ventilators force the outside air in, the air is directed by means of valves to absorbing filters (if the air happens to be contaminated), or the air is allowed to bypass the filters.

As a rule, shelters have at least two entrances placed at different sides, but basement shelters also have emergency underground tunnels, with their exits leading beyond the possible danger zone of collapsing buildings.

The entrances are fitted with airlocks. There are two doors at each airlock, the outside and inside doors, which provide dual airtight protection.

The airtight outside door not only prevents against the possibility of contaminated air entering the shelter, but also shields against blast waves. The inside door is also airtight.

Shelters provided for the civilian population are operated by units of the self-defense and buildings' organizations of the MPVO. The personnel are responsible for the operation of equipment in shelters, for observance of rules while the shelters are used during air raids, for starting and stopping ventilation systems, etc. The teams are also responsible for systematic inspections of "air braces." If an "air brace" is faulty, i. e., if the higher inside air pressure does not equal 5 mm of a water column while one-half of the volume of air in a shelter is being replaced, deficiencies in air tightness are immediately determined and eliminated. The "air braces" are measured with brachimeters that resemble sloping pressure gauges (figure 18). One end of the brachimeter is connected to a gas tube that leads to the outside of the shelter; the other end remains open. During the operation of a filtered ventilation system, the magnitude of "air brace" is determined according to the displacement of the level of the liquid in the glass tube of the brachimeter.

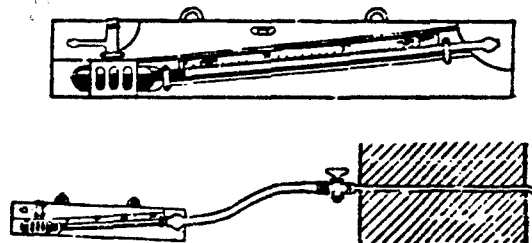


FIGURE 18

BRACHIMETER OR SLOPING PRESSURE GAUGE

All refugees in shelters should follow the instructions and orders of the personnel in charge, because their safety and protection depend in large measure upon the proper use of shelters and upon the individual parts of equipment in the shelters.

As long as there is contaminated air outside no one can enter or leave the shelter. A gas mask may be put on only on orders of the team in charge of a given shelter. The gas mask may not be taken off except upon orders of the same team. Smoking in shelters is prohibited, and movement without specific reason is not permitted.

D. Protection of Food, Water, and Articles of Everyday Use Against Contamination by Chemical Agents.

All kinds of tightly covered dishes can be used for the protection of food and water.

An excellent storage place for food can also be found at home in a refrigerator and in wooden boxes free of cracks, if they are tightly covered with some type of packing material. It is recommended that such boxes be lined on the inside with cellophane, oilcloth, or with several layers of paper.

Flour, groats, and other loose items should be kept in sacks made of thick fabric and should be stored in covered boxes. Fresh food, such as meat, fish, vegetables, and fruits should be stored in tightly covered boxes, cupboards, vats, or refrigerators; butter and fats should be kept in a covered dish of glass or metal.

Dishes, clothing, footwear, linen, etc should be stored in covered boxes, trunks, and closets.

All storage places, where food, grain, etc are kept should be as airtight as possible. Furthermore, food and grain, when stored, must be kept in a packing container, or be well covered with canvas and other materials.

Artesian wells and other sources of water that produce water from deep strata of the earth, should be protected against contamination by booths erected above them, or by sheds and tightly covered lids. Water in drilled (shaft) wells can become contaminated not only through the main inflow openings but also through cracks in the shaft, especially when contaminated rain water or sewer water starts seeping in. In order to avoid such contamination the outer part of a well's frame should be covered with clay and an area of 1 1/2 to 2 m around the frame should be filled with well compressed clay, up to 20 cm above the original surface. A mixture of soil and sand, up to 15 cm high, should be placed on the first layer; this is called a clay pad. The inflow openings leading to wells should be provided with thick and well fitting hatches. Finally, it is recommended that a shed be constructed over the well.

All means and measures that protect food, water, and other articles of everyday use against contamination by chemical agents, also protect against contamination by radioactive substances and disease-producing germs and toxins.

E. First Aid after Contamination by Chemical Agents.

In all cases of contamination, the victim should, above all, be isolated from additional effects of the agent; a casualty should be evacuated from a contaminated area.

If, for some reason, the victim has no gas mask, or has a leaky gas mask, he must first be protected by an emergency gas mask carried by the individuals giving first aid. If the enemy uses agents that attack the skin, or through the skin, it is necessary to examine the victim's face and head before the gas mask is put on. If drops of agent are discovered, they should be wiped off with gauze, cotton, or with the tampons found in the gas-casualty first-aid kit, and only then may the gas mask be put on.

After the victim has been led or carried out of the contaminated area the gas mask should be removed; if his clothing is heavily contaminated, it must be taken off. After this, the victim should be given first aid.

After contamination by liquid agents that cause blisters, the contaminated areas should be treated with compounds found in the chemical warfare protective packet (IPP).

This packet includes a small bottle that contains 100 ml of decontamination liquid. The bottle is contained in a little gauze bag that is packed in a cellophane or paper wrapper; an additional gauze pad is on top of the bottle. When moistened with the decontamination liquid, the little gauze bag can be used to wipe off contamination spots found on clothing. This procedure may be necessary, when the victim's clothing cannot be taken off (e. g., first aid is given in cold weather, or outdoors). The gauze pad can be used two or three times, after it has been soaked with the decontamination liquid.

Other types of protective packets are also available. There is, for example, a packet that resembles a box containing large and small containers filled with liquids, but one large container among them has an ampoule filled with powder. There is a device attached to the cover of the box for puncturing the tops of the containers. After the ampoule is broken, its powder is removed for mixing with the liquids found in the large containers and this produces a decontaminating agent. There are in the same box four ampoules that contain an antismoke compound and four more gauze pads.

Prior to treatment of any part of the skin with the protective packets, contaminated parts should be thoroughly washed with water.

If a chemical warfare packet is not available, the surface of the skin should be cleaned with benzene, kerosene, or just thoroughly washed with warm water and soap.

The contents of the chemical warfare packets should not be used for treating the eyes. Eyes should be washed with a 2% solution of baking soda, or with clean water.

After contamination by vapor and fog of blister agents, it is necessary to wash the eyes and rinse the mouth, nose, and throat.

After contamination of the respiratory organs, it is necessary to direct the victim to a medical station immediately after first aid has been given.

Upon contamination by prussic acid, first aid should be given within the shortest possible time; otherwise the victim may die.

As soon as the victim can be protected with a gas mask, the ampoule wrapped in cotton or gauze and containing amyl nitrate, should be crushed and put under the facepiece of the gas mask. The victim should then be removed to fresh air, his gas mask taken off, and, as soon as practicable, sent to a medical station. If the victim's respiration is very weak, or has stopped, he should be given artificial respiration prior to being sent to a medical station. He should, at the same time, be given amyl nitrate and oxygen.

After contamination by vapor or fog of Sarin and tabun, first aid should be given in the same way that was described for contamination by prussic acid.

If liquid Sarin or tabun comes in contact with the skin, the place should be treated with a 15% aqueous solution of ammonia, and contaminated clothing should be removed.

After contamination by carbon monoxide, the victim should either be given a gas mask with a hopcalite filter or be taken from the contaminated atmosphere. His clothing should be loosened, his body warmed, and oxygen administered. If the victim loses consciousness and stops breathing, artificial respiration should be applied simultaneously with the oxygen, or with a mixture of oxygen and carbon dioxide.

After contamination by tear gas, the first aid can be limited in most cases to giving the victim a gas mask and taking him out of the contaminated atmosphere. A prolonged irritation of the eyes should be treated by washing with a 2% solution of baking soda or with clean water.

After contamination by irritants that attack the upper respiratory tract, the mouth and throat should be rinsed with water, and the nose should be washed with a 2% solution of baking soda, with a 3% solution of boric acid, or with clean water. The victim should inhale the antismoke compounds found in the chemical warfare packet.

After contamination by suffocating agents, the victim, protected by a gas mask, should be taken out of the contaminated atmosphere. He must not be allowed to move unassisted, even if he insists that he is feeling better. Any physical stress imposed upon a victim of suffocating agents tends to aggravate the effects. Clothing should be loosened and oxygen administered; the victim should be kept warm and in complete rest. Under no circumstances should artificial respiration be administered, because it may cause injury to lung tissues. If the eyes, nose, and throat are affected, they should be rinsed with a 2% solution of baking soda, or with clean water.

F. Identification of Chemical Agents.

Successful utilization of the various means and measures for protecting against chemical attack can be secured with: (1) early detection of agents in the air, on the ground, in water, or on various objects; (2) quick identification of the nature of the agent present; and (3) instantaneous warning transmitted to the public about the imminent danger.

The agents can be detected and identified with the aid of special devices, and by their external characteristics.

Agents can be detected and identified by odor and irritant effects only when a person fails to put on his gas mask in time during a chemical attack by the enemy, or when the gas mask being used develops leaks. It is prohibited to suggest detection and identification of agents by their odor and irritant effects, because the procedure is too dangerous to health and life. Furthermore, some agents have neither odor nor irritant effects.

There are special devices for the detection of agents, which show the chemical reaction of agents to certain substances, i. e., to the so-called indicators. The indicators change color only when specific agents react chemically with specific indicators. There must be a specific indicator in the detection device for every agent or group of agents. Detection and identification of agents with the aid of special devices is, consequently, the safest and most dependable and convenient method.

There are several types of devices available for detecting and identifying agents. These have been issued to the self-defense teams and to other organizations of the MPVO.

The simplest device is the Simplified Detector (UPI). It resembles a flat metal box, in which a set of glass indicator tubes is assembled, and it has a small hand pump. The pump's headpiece has an interchangeable smoke filter. There is also an instrument for breaking the ends of the glass tubes, a calibration table listing variations pertinent to the indicators' colors, etc. The presence of chemical vapor is determined by pumping contaminated air into the indicator tubes. The pumping is done with the pump into which an indicator tube can be inserted. If it becomes necessary to determine the presence in the air of vapor, which has some admixture of smoke and the smoke might change the color of the substance in indicator tubes, a headpiece with a smoke filter is put on the indicator tube connected to the pump. The smoke filter will eliminate the possibility of smoke reaching an indicator tube and reacting with its contents. The vapor can, however, pass freely through the smoke filter and enter the indicator tube.

The instruments for chemical reconnaissance are more efficient. They can determine the presence of agents in the air, on the ground, and on various objects, and they can identify agents absorbed into the ground or that have contaminated food. These instruments are equipped with a gadget that enables taking of samples of contaminated materials, soil, and snow, and also samples of particles found in toxic smoke. These samples can be analyzed at a laboratory, and thus a timely detection of new agents or determination of their nature is facilitated.

G. Means and Methods of Decontamination.

1. Determination of the Meaning of Decontamination and Classification of Decontamination Methods.

Decontamination is the process of neutralizing terrain, premises, and various objects contaminated by chemical agents.

The methods of decontamination are listed below.

a. Chemical.

In chemical methods, chemical agents are decontaminated with the aid of substances that react chemically upon the agent. The agents are destroyed by being changed into harmless compounds or compounds having little toxicity.

b. Physical.

In physical methods, agents are washed off with the aid of solutions that remove the agents mechanically from contaminated surfaces, ventilate the surfaces, and isolate them from other contaminated areas.

c. Physical-Chemical.

In this method, agents are subjected to evaporation and to simultaneous decomposition by streams of hot air or steam, by burning, etc. Natural decontamination should also be mentioned here as it causes evaporation of agents, or if it results from decomposition of the agent because of humidity, or dampness of the ground.

The compounds and technical means and devices with which decontamination is usually carried out are very diversified. The selection of a method depends on the agent to be decontaminated and the conditions under which this agent can be made harmless.

2. Decontaminating Agents.

Decontaminating agents are substances that react chemically with chemical agents in such a way that the agents being destroyed either form harmless substances or substances having little toxicity.

a. Bleaching Powder.

Bleaching powder is one of the main decontaminating agents. It is a white powder and contains 28% to 35% of active chlorine (the amount of active chlorine characterizes decontaminating capacities of many decontaminating agents). Bleaching powder is a very unstable compound; it decomposes rapidly in the air by absorbing carbon dioxide and particularly moisture, losing its decontaminating properties and forming lumps. High temperatures and light also have a deteriorating effect on bleaching powder. Consequently, many precautions are taken during transport and storage of bleaching powder. The powder is usually stored and transported in wooden barrels of 50- to 100-liter capacity. If a barrel has been opened but has not been completely used, it is necessary to cover the top of the remaining powder with a layer of sand or sawdust 5 to 10 cm thick, and to cover the barrel with a lid. Bleaching powder should be stored in dry, dark, and unheated places, where it can be checked at periodic intervals during dry weather.

Bleaching powder reacts strongly upon metals (especially copper) causing their corrosion. Consequently, all metallic parts of equipment used for work with bleaching powder should be well painted, and upon completion of the work the parts should be carefully washed, wiped dry, and lubricated. Bleaching powder should not be used for the decontamination of either fine mechanisms or polished metallic surfaces.

Human skin affected by bleaching powder hardens, becomes rough, and cracks; mucous membranes become inflamed. Bleaching powder destroys and bleaches clothing and damages footwear. Consequently, a gas mask should be used, and the agents for skin protection should be available when working with bleaching powder.

Bleaching powder is used for the decontamination of surfaces contaminated by mustard, lewisite, and nitrogen mustard. The reaction of dry bleaching powder upon these agents in liquid form is not only vigorous, but is also associated with a considerable emission of heat; at times, even a flash of flame is visible. Consequently, precautionary measures (such as mixing of bleaching powder with water, sand, or soil) must be adopted during decontamination of any locality highly contaminated by agents in liquid form.

The specific consumption rate of dry bleaching powder for decontamination purposes is 400 to 500 gm/sq m of area contaminated by mustard or lewisite. This rate is doubled if an area is contaminated by nitrogen mustard. Dry bleaching powder is used for decontaminating streets, town squares, yards, bridges, and open fields covered with low vegetation (up to 10 cm). Bleaching powder reacts poorly with chemical agents at temperatures below 50C, making it unsuitable for decontamination during cold weather.

Bleaching powder can be used as a slurry for decontaminating walls, weapons, and other vertical surfaces, and for decontaminating wooden parts of equipment and vehicles, heavy objects made of metal, and glass surfaces. Bleaching powder can also be used as milk of lime for decontaminating some flat surfaces and objects.

One or two parts bleaching powder are mixed with one part water (by volume) to make a slurry, but only one part bleaching powder is mixed with two parts water to prepare milk of lime. Milk of lime and slurry are prepared immediately prior to decontamination, because they decompose quickly. The consumption rate of slurry is 1 l/sq m of horizontal surface and up to 2 l/sq m of vertical surface. The consumption rate of milk of lime is 2 l/sq m. The areas decontaminated by bleaching powder become safe for crossing in ordinary footwear within 30 minutes after decontamination.

b. Two-Thirds Based Salt of Hypochlorite of Calcium (DTC GK).

This is a white powder with an odor like that of chlorine; it is approximately 56% active chlorine. It is not soluble in water. A solution of one part of salt to four parts of water (by volume) is used at temperatures no lower than 50C for decontaminating weapons, equipment, and certain parts of the ground.

c. Sulfuryl Chloride (DZH).

This compound is a yellowish transparent liquid with a sharp odor. It has up to 60% active chlorine. Its vapor causes coughing, suffocation, lacrimation, and skin irritation. Liquid sulfuryl chloride causes burns, corrodes metal, and damages clothing and footwear. It reacts with mustard, lewisite, and nitrogen mustard in winter and summer, but it is particularly valuable for decontaminating the ground during winter when bleaching powder and two-thirds based salt of hypochlorite of calcium cannot be used for these purposes. Thus, sulfuryl chloride is mainly intended for decontaminating the ground at temperatures below 50C. It is used in its pure state or as a 50% solution with dichlorethane. Its consumption rate is 0.8 to 1 l/sq m.

d. Sodium Sulfide.

This compound is a solid grayish-brown mass with an unpleasant odor of hydrogen sulfide. It dissolves well in water and alcohol. It may be used for decontaminating thick wood, metal, and glass surfaces, and ground contaminated by lewisite and agents of the Sarin type. A 30% aqueous solution of sodium sulfide is sufficient for decontaminating various objects, and a 10% aqueous solution is suitable for decontaminating the ground. Sodium sulfide, in its solid state or in solution, causes burns, destroys tissues, and damages footwear.

e. Caustic Soda.

Caustic soda resembles small white or dingy-looking chunks. It has a high absorption rate of moisture, and it dissolves in the air. Its aqueous solutions can be used for decontaminating the ground and premises contaminated by agents such as lewisite, or those of the Sarin type.

f. Monochloramine B (DT-1).

This compound is a yellowish crystalline substance with an odor of chlorine. It dissolves well in water and alcohol. It is used in aqueous or aqueous-alcohol solutions for decontaminating skin, hair, clothing, and thin metallic objects contaminated by persistent vesicant agents.

g. Dichloramine B (DT-2).

Dichloramine is a white or yellowish crystalline powder with an odor of chlorine; it contains up to 61% active chlorine. It does not dissolve in water. It dissolves readily in dichlorethane but with difficulty in carbon tetrachloride, especially during winter. It is used in a 10% solution with dichlorethane for decontaminating metal and wooden objects contaminated by persistent vesicant agents. Its consumption rate is 0.5 to 0.7 l/sq m of surface to be decontaminated.

h. Dichloramine T (DT-2T).

This compound is a yellowish crystalline powder with an odor of chlorine. It contains 59% active chlorine. It is used (like dichloramine B) in a 10% solution with dichlorethane for decontaminating metal and wooden objects contaminated by blister agents.

i. Hexachloromelamine (DT-6).

Hexachloromelamine is a yellowish crystalline compound with an odor of chlorine. It does not dissolve in water, but dissolves well in dichlorethane. It is explosive in its dry state, and it is, therefore, stored in solution. It is used as an 8% solution with dichlorethane for decontaminating metal and wooden objects contaminated by persistent agents of the vesicant type.

j. Aqueous Ammonia.

Aqueous ammonia is a transparent aqueous solution containing 20% to 25% of ammonia (aqua ammonia). It is used for decontaminating skin and hair contaminated by Sarin or liquid tabun. It also can be used for decontaminating objects contaminated by diphsogene, lewisite, and agents of the vesicant type. Aqueous ammonia destroys these agents in their liquid and vapor forms. Ammonia vapor obtained from cylinders or from bicarbonate of ammonia (a white crystalline substance) is mixed with an aqueous vapor and is used for decontaminating clothing contaminated by persistent agents. The ammonia is essential for neutralizing hydrochloric acid and its vapor, which form during decomposition of agents by hot steam. The neutralization is necessary because hydrochloric acid and its vapor cause damage to clothing.

k. Hot Water (70°C) and Steam.

This combination destroys many agents and is used for decontaminating linen, clothing, and items made of rubber contaminated by vesicant agents.

l. Hot Air (60°C to 100°C).

Hot air causes evaporation and partial destruction of many agents. In the absence of more effective means, hot air can be used for decontaminating linen, clothing, and items made of rubber that are contaminated by Sarin or tabun; it can also be used to decontaminate leather, fleecy and rubber items, oil-treated fabrics, felt boots, padded jackets, and tarpaulins contaminated by blister agents. Hot air for decontamination of these articles is usually combined with hot steam and ammonia. This method of decontamination is called the air-steam-ammonia process.

A blow torch can be used to decontaminate articles by burning.

Decontamination with fuels can be carried out only on a limited scale in the absence of other decontaminating agents and under complete fire safety control.

3. Local Decontamination Agents.

In the absence of agents for decontaminating street and road surfaces, or for decontaminating solid and smooth ground without vegetation, or objects made of wood, brick, concrete, etc, which have been contaminated by persistent agents, local decontamination agents can be used. Among these are dry and pulverized clay, loam and peat, slaked and unslaked lime, dolomite, marl, various ashes containing alkali, and liquid industrial refuse that contains alkali or active chlorine.

Decontamination, in which local decontamination agents are to be used, should not be done at temperatures below 0°C.

The consumption rate of dry local decontamination agents is 1 kg to 2 kg, and that of liquid agents 1.5 to 2 l/sq m of area to be decontaminated.

4. Solvents.

There are many organic substances that will readily dissolve chemical agents. This characteristic of solvents should be used for eliminating persistent agents from surfaces of materials and objects that do not allow agents to penetrate them; e. g., metal and glass surfaces and the surfaces of glossy items made of hard stock wood. Solvents cannot eliminate agents from porous materials, and solvents cannot neutralize agents. As agents are removed from contaminated surfaces, the solvents become harmful and they should either be destroyed or neutralized.

The following can be used as solvents: kerosene, gasoline, crude oil, alcohol, benzene, dichlorethane; carbon tetrachloride, etc.

5. Decontaminating Agent Solvents.

Dichlorethane dissolves dichloramines, hexachloromelamine, and sulfuryl chloride. Dichlorethane is a colorless or yellowish, toxic liquid with a faint and pleasant odor; it does not dissolve in water, or mix with water; it does not react with metals and does not freeze in winter.

Carbon tetrachloride dissolves dichloramines and sulfuryl chloride. Carbon tetrachloride is a colorless liquid with the sweet odor of chloroform. It is not used as a solvent in winter.

6. Isolating Materials.

Isolating materials are used for the construction of passages

through sectors of a contaminated area; they can also be used in the absence of decontaminating agents.

Passages can be filled with uncontaminated soil, sand, coal clinkers, sawdust, etc. If trails must be built, they should be paved with planks and be provided with little wooden bridges made of poles, bricks, sheets of plywood, etc. Small sectors contaminated by liquid agents should be filled with sawdust, sand, coal dust, or other porous materials. These materials absorb basic substances of liquid agents and their vapor. In some instances, they assist in a partial decomposition of the agents, although they do not provide complete decontamination of contaminated surfaces. Any porous material that has absorbed an agent must be removed and either destroyed or neutralized by decontamination.

Some paints and lacquers having a special composition that resists the absorption of persistent agents can also be included among the isolating materials. These lacquers and paints protect some objects against the destructive effects of agents and can be decontaminated much easier.

7. Decontamination Vehicles, Devices, Installations, and Appliances.

a. Sieve-Wheelbarrow.

A sieve-wheelbarrow is the simplest device generally available to personnel of the MPVO for decontaminating small areas of rough terrain (gutters, ditches, craters left by chemical aerial bombs, etc) with powdered decontamination substances.

The wheelbarrow, which looks like a wooden box with its handles folded back, has a sheet iron bottom with a built-in sieve, and it is used for scattering decontaminating agents. The holes in the sieve are 5 mm in diameter and are placed at intervals of 1.5 cm. The box is 75 cm long, 50 cm wide, and 18 cm deep.

The device holds 20 kg of bleaching powder: an area of approximately 50 sq m can be decontaminated in 3 minutes with one load of bleaching powder scattered at an average density of 400 gm/sq m. The decontamination capacity of the wheelbarrow is 750 sq m/hr.

The device can be reloaded in approximately 1 minute.

The sieve-wheelbarrow is operated by four personnel: two carry the decontaminating agent and reload the device, and two operate the device.

b. Wheeled Decontaminating Device (VDP).

The device is used by personnel of the MPVO for decontaminating small level sectors of the terrain, yards, sidewalks, passages, etc with powdered decontaminating materials.

The device is a metal box (bin) mounted on a two-wheeled cart.

The cart (figure 19) is equipped with a shaker, sifter regulator, and a shifting device for idling, forward, and reverse.

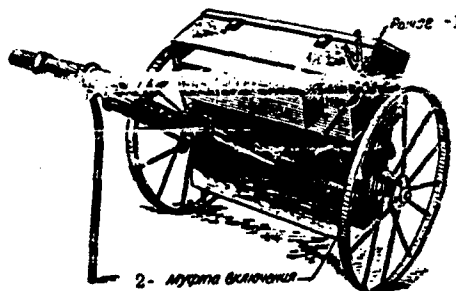


FIGURE 19

WHEELED DECONTAMINATING DEVICE (VDP)

1. Lever, 2. Switch coupling

The shaker is located in the box above the axis of the device. When the device is in motion, the shaker turns and loosens the decontaminating agent assuring uniform sifting.

The sifting control permits changes to be made in sifting rates from 200 to 1000 gm/sq m.

The shift device, which changes from idle to forward and reverse, is positioned on the right side of the cart. It consists of a clutch connected to the operating axis; there is also a lever for moving the clutch. This enables the pins in the bushings on a wheel to make a contact with the clutch (operational running), or to become disengaged from the clutch (idling).

The device weighs 53 kg.

The box (bin) holds approximately 55 kg of bleaching powder. The width of each strip decontaminated is approximately 90 cm. In 5 to 6 minutes, one load of bleaching powder allows decontamination of an area of approximately 125 sq m with a rate of sifting density of 400 gm/sq m. The decontaminating capability of the device is approximately 100 to 1000 sq m/hr.

Three individuals operate the cart: one pushes the cart using a hand grip; two carry decontaminating material and load it on the cart. Reloading requires approximately 1 minute. Because of some deficiencies, the production of the VDP device has been discontinued and another device is being manufactured instead.

c. Wheeled Decontaminating Sower (SVDP).

The wheeled decontaminating sower is a new model of the above cart. It is a cylindrical bin mounted on a two-wheel cart (figure 20). As the sower is pushed forward, the bin, operated by a special working principle, is agitated and sifts decontaminating agents uniformly.

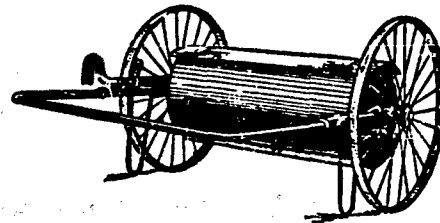


FIGURE 20

WHEELED DECONTAMINATING DEVICE (SVDP)

The device weighs 55 kg when empty.

The bin holds approximately 80 kg of bleaching powder. The width of each decontaminated strip is 1 m. One load of bleaching powder decontaminates an area of 200 sq m in 3 to 4 minutes.

Three persons operate the device: one pushes the cart forward; two carry decontaminating agents and load them on the cart. Reloading requires approximately 1 minute.

The decontamination capability of the device is approximately 2000 sq m/hr.

d. Ground Decontaminating Apparatus (PDM).

This device is used by personnel of the MPVO for decontaminating large areas with powdered decontaminating agents (figure 21). The apparatus is a wooden frame attached to the body of a truck. The frame has one rear wall and two side walls. The truck tail board lowered down at 45° angle provides the fourth wall for the device. The walls of the frame and the truck tail board connected to it form the bin. The sifter roller is positioned in the lower part of the bin, and is driven by a motor. The left end of the sifter roller is provided with a drive sprocket wheel, which is connected (by a chain) with the driving sprocket wheel mounted on the left rear wheel of the truck.

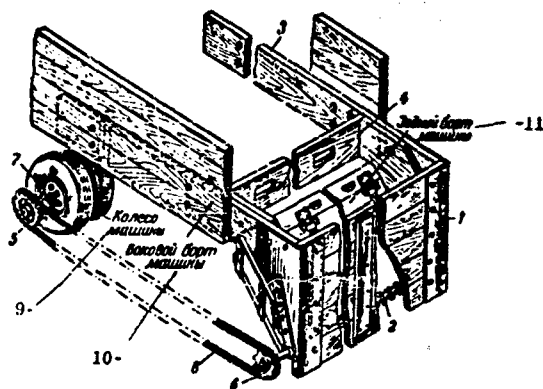


FIGURE 21

GROUND DECONTAMINATING APPARATUS (PDM)

1. Pin, 2. Sifter roller, 3. Guiding boards, 4. Transverse shuttling board, 5. Sprocket wheel with 14 cogs, 6. Sprocket wheel with 8 cogs, 7. Bracket, 8. Chain, 9. Truck wheel (truck), 10. Side boards, 11. Rear board

The truck is loaded with a decontaminating agent packed in barrels or in bulk, in amounts suitable to the capacity of the truck. Two or three men on the truck are the assigned service crew. Working with shovels, they refill the bin with decontaminating agents uniformly and continuously.

As the truck moves, the sifter roller revolves and scatters decontaminating agents uniformly over the ground. The truck travels at a speed of 10 to 12 km/hour during operation. The density of sifted agents varies between 400 to 500 gm/sq m. Each turn of the truck produces a decontaminated strip approximately the width of the body of the truck.

e. Truck-Towed Decontamination Device (PDP).

This equipment operates in the same way as the PDM device. It is attached to the following types of truck: GAZ-51, GAZ-63, and ZIS-150. The basic parts of the device are the bin with its sifter mechanism, and the chain drive, which extends from the hub of the rear right wheel of the truck to the shaft of the drum with its sifter mechanism. The bin is made of metal and is equipped with a control lever with which the density of sifting can be regulated. The operational features of the PDP unit are the same as those of the PDM device.

The bodies of the GAZ-51 and GAZ-63 trucks can be loaded with 1300 kg to 1500 kg of bleaching powder; the loading capacity of the ZIS-150 truck is up to 2500 kg. Consequently, at an average consumption rate of 0.5 kg of bleaching powder per sq m, one load can cover between 2600 and 5000 sq m of contaminated area. The PDP device is operated by special units of the MPVO.

f. Portable Decontamination Device (RDP).

This equipment is used for liquid decontaminating agents or for solvents and is for decontamination of various weapons, pieces of equipment, and other objects contaminated by persistent agents. This portable decontaminating device can also be used for decontaminating contaminated air in closed areas. The device is especially suitable for decontamination of vertical surfaces.

The apparatus (figure 22) is a metal tank that is filled with decontamination liquid. Air pressure is built up in the tank with the air pump. The pressure forces the decontaminating liquid out of the tank, into the rubber hose, and through the outflow hose. When the liquid reaches the nozzle through the open petcock, it escapes in spray form and sprinkles the object being decontaminated. One person carries the device on his back. The operating capacity of the device is 8.5 liters. It weighs approximately 8.5 kg empty,

and approximately 18 kg when full. The length of the spray is 2 m. During decontamination, the spray nozzle is held at a distance of 30 cm to 40 cm from the surface being decontaminated.

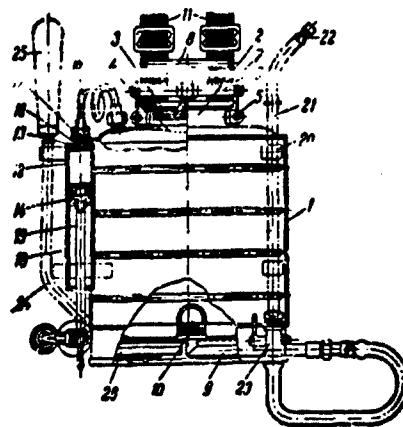


FIGURE 22

PORTABLE DECONTAMINATION DEVICE (PDP)

1. Tank, 2. Opening, 3. Casing cover, 4. Strainer,
5. Lugs, 6. Little bow, 7. Balance beam, 8. Support-
- ing screw, 9. Drain tube, 10. Outlet filter, 11. 20. 21.
- straps, 12. Piston cylinder, 13. Cap, 14. Piston,
15. Rod, 16. Valve ball, 17. Spring, 18. Opening for
- pumped air, 19. Air tube, 20. Clamp, 21. Outflow hose,
22. Spray nozzle, 23. Petcock, 24. Stem in idle position,
25. Handle, 26. Box for spare parts

g. Decontamination Tank Truck (ARS).

This truck is operated by special units of the MPVO. The truck is used for decontaminating streets and squares with decontaminating (disinfecting) solutions. The vehicle can also be used for decontaminating vehicles.

s 2 m. ...
cm to 40 c.

The ARS vehicle (figure 23) has a tank mounted on the chassis of a ZIS-151 truck; it is equipped with mechanical and hand-operated pumps and a system of pipe lines. Its operational capacity is 2500 liters. Decontaminating liquid is poured into the tank through an opening on top. The mechanical pump, which is operated by the truck engine, is used for refilling the tank with liquid. The output of the mechanical pump is up to 300 l/min. A hand-operated pump is used when the mechanical pump is out of order. The output of the hand-operated pump is 40 l/min. The pipe lines are controlled by a system of tubes and valves that allow the tank to be filled with decontaminating liquid directly from barrels or other containers; they are also used to deliver the liquid via distribution tubes to the spray nozzle (decontamination nozzle), which is located at the end of the tank.

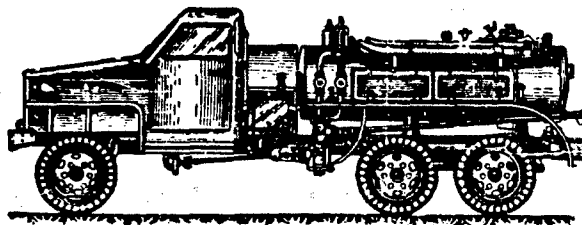


FIGURE 23

DECONTAMINATION TANK TRUCK (ARS)

The tank truck travels at a speed of 5 to 7 km/hr when decontamination is being carried out. Thorough decontamination requires two or four turns of the vehicles over the same area.

The tank is equipped with a header for eight connecting pipes, which have a corresponding number of hoses and spray nozzles for use in the decontamination of motor vehicles. Simultaneous decontamination of several

DDP)

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Support-

1. Shoulder

ston.

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flow hose,

ile position,

motor vehicles (up to eight) or other objects can, consequently, be used.

For decontamination operations, towns and rural areas can also use many other vehicles, devices, and improvised means, such as equipment of the building and highway construction departments or of some branches of industry.

Among the motor vehicles employed in rural areas the following can be used for decontamination: sand scatterers, watering trucks, sweeper trucks, snowplows, and other vehicles.

h. Sand-Scattering Truck.

Sand-scattering trucks are used for strewing sand on streets and sidewalks covered with ice. A sand truck provided with a bin and a sifting mechanism can be used to decontaminate the ground by scattering decontaminating agents. The PM-1 sand scatterer is mounted on the chassis of the ZIS-150 truck. Its capacity is 2.5 cu m and the width of dispersion is 6 m.

i. Watering Truck.

Watering trucks (figure 24) can be used in decontamination operations for washing surfaces of streets and squares with water, and for decontaminating and disinfecting with solutions. Some types of water trucks can be equipped with plows and brushes for cleaning and sweeping (figure 25).



FIGURE 24

WATERING TRUCK

Water trucks can also be used for decontaminating vertical surfaces. Plows and brushes can be used for cleaning, prior to decontamination, mud and snow from bridges contaminated by chemical agents. The PM-8 water equipment is mounted on the chassis of a ZIS-150 truck. The tank capacity is 6000 liters, the width of washed strip is 6 m, and its operational speed is 5 to 6 km/hr.

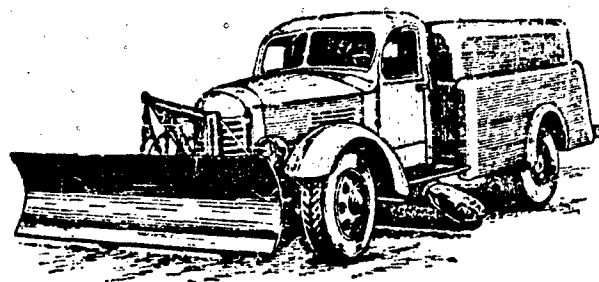


FIGURE 25

WATER TRUCK EQUIPPED WITH PLOW AND BRUSH

j. Sweeper Truck.

The sweeper truck (figure 26) is used for sweeping and cleaning rubbish from bridges. It can also be used for cleaning dirt and rubbish from bridges prior to chemical and radiological decontamination, and also for scrubbing wet decontaminating (disinfecting) agents deposited on bridges.

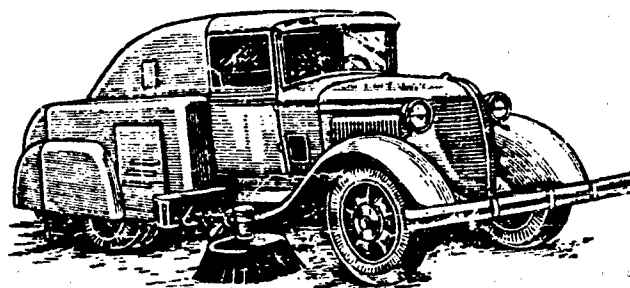


FIGURE 26

SWEEPER TRUCK

k. Snowplows, Snowshovels, and Snow Loading Equipment.

These vehicles (figure 27, 28) and other vehicles for snow removal, can be used for cleaning snow contaminated by toxic or radioactive agents or snow polluted by decontaminating agents.

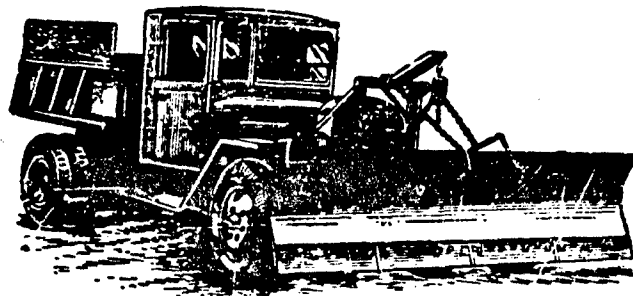


FIGURE 27
SNOWPLOW

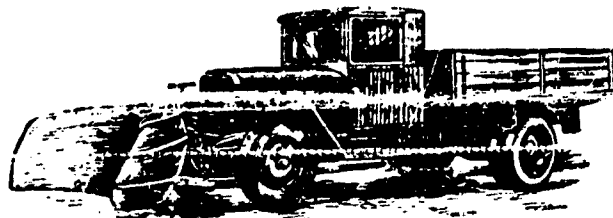


FIGURE 27
SNOWSHOVEL

A snowplow clears a 2.6-m-wide strip, removing snow up to 25 cm deep. Its speed is 25 km/hr. A snow plow attached to a tractor clears an 8-m-wide strip at a speed of 1.5 km/hr.

1. Miscellaneous Vehicles.

Among the vehicles used in rural areas, lime spreaders and manure spreaders can be useful for decontaminating purposes. Various spray pumps, hand-operated and mechanical, can be used for decontaminating the ground, buildings, and other objects with decontaminating solutions.

Buildings, factory equipment, machines, benches, etc can be decontaminated with solutions applied with paint sprayers. Cement mixers and other equipment used in building construction can be used for spreading slurries.

Graders, bulldozers, scrapers, and other machinery employed in highway construction can be used for removing top soil contaminated by radioactive or toxic agents. The D-165 heavy grader scrapes a layer of soil up to 3 m wide and has a capacity of 2 to 3.5 linear km/hr. The D-157

bulldozer, which is operated with the C-80 tractor, and has a capacity of 1.5 to 6 hectares per shift. The D-188 scraper is equipped with a 3.15-m-wide blade, and has a capacity of 1 linear km/hr.

A brushwood ripper should always be used prior to decontaminating places covered with brushwood. The D-174 brushwood ripper, which is used with the C-80 tractor, clears a 3.5-m-wide strip of bushes; its capacity is 1 to 3 linear km/hr.

Various types of steam-operated equipment found in factory areas or assigned to the transportation system, can be used for decontaminating with steam.

Bucking houses (laundries) are equipped with special boilers or tanks that are used for decontaminating articles made of cotton or linen, and articles made of rubber or rubberized items, which are boiled in water solution containing anhydrous sodium carbonate.

8. Improvised Decontamination Devices.

Various improvised decontamination devices can be used in the absence of standard ones.

Shovels, for example, can be used to scatter decontaminating agents and rakes and brooms can be used for mixing the substances and spreading them evenly. Shovels, scrapers, and brooms can be used to remove contaminated snow. Buckets, paint brushes, soaked bast brushes, and mops can be used to decontaminate buildings by applying slurries made from decontaminating agents. Liquid decontaminating agents, solvents, and fuel mixtures can be spread with watering cans and other devices.

9. Methods for Decontaminating Installations Contaminated by Persistent Agents.

In urban and other populated areas, attention during decontamination should be given first to the craters left by exploded chemical aerial bombs, then to building passages through contaminated sectors in order to evacuate casualties and the population; next, decontamination should be directed to sectors where rescue work and emergency maintenance work would be needed first. All remaining contaminated territory including buildings should then be decontaminated. The first efforts should be directed to decontaminating sectors and installations that are essential to the restitution of the normal activity of the town, populated area, or industrial center.

Areas that cannot be decontaminated by available means and sectors closed to the population for a prolonged time should be left to the natural decontamination process. Such sectors should be enclosed and marked with warning signs.

Craters left by chemical aerial bombs can be made harmless by filling with dry decontaminating agents or by spraying with decontaminating solutions. If dry bleaching powder is used, it should be mixed with dirt and sand, or sprinkled with water to prevent ignition that results from reaction of the powder with chemical agents. Debris thrown out of bomb craters by the explosion should be collected and dumped back into the bomb crater, and the crater should either be filled or sprayed with decontaminating agents. If it is found to be contaminated by liquid agents, terrain around the bomb crater should be neutralized by decontaminating agents.

Paths through contaminated areas should be at least 45 cm wide. They can be made using decontaminating agents or improvised floors, by building raised paths 8 cm to 10 cm high of isolating materials, or by removing 8-cm to 10-cm deep strips of contaminated soil in an open field and 20-cm to 25-cm deep strips of contaminated snow. Floors can be built of poles, boards, bricks, or other materials. Bricks or logs should be placed under the floors, if they are built like little bridges of boards or poles. The boards should overlap one another where they meet in such a way that the ends of the top board face the direction in which people are going when passing over these bridges. This is necessary to prevent individuals passing over the bridges from stumbling over the boards and stepping into contaminated places. The construction of floors and paths of isolating materials is only a temporary measure. After evacuation, all raised paths and floors should be removed to specially prepared areas, and the paths should be made harmless by decontaminating agents.

Streets, squares, and yards, with artificial surfaces, should be decontaminated during warm weather in the following way. A contaminated sector is first sprinkled with dry decontaminating agent and it should then be sprayed with water (0.5 l/sq m) for 5 to 10 minutes. As the slurry of the sprinkled decontaminating agent starts forming, it should be scrubbed with stiff brush or brooms, or it should be swept by cleaning trucks. The sitting and scrubbing contribute to the better mixing of chemical agents and decontaminating agents, and this speeds decontamination. After two or three scrubblings, the decontaminating agent should be washed off with water, and either cleared away with brooms and shovels or with sweeper trucks.

In strong winds, a contaminated sector should be sprayed with water prior to decontamination and then sprinkled with decontaminating agents.

The same procedure should be used, if streets, squares, or yards are dusty or highly contaminated. Dirt and dust should be washed off to the sewerage system and, after the decontamination agent has been scattered, additional spraying of water is not necessary.

Streets, squares, and yards with artificial surfaces can also be decontaminated during warm weather by using aqueous solutions made of two-thirds based salt of hypochlorite of calcium, and by aqueous solutions of alkali, if the area is contaminated by liquid agents of the Sarin type.

After decontamination of asphalted surfaces, it is necessary to determine how complete the results are, and, if they are incomplete, decontamination must be repeated, because drops of persistent agents penetrate the surface of asphalt to a depth of 4 cm. Streets, squares, and yards covered with blockwood pavement and bridges with wooden floors should be decontaminated during warm weather with slurries made of bleaching powder or with solutions made of two-thirds based salt of hypochlorite of calcium. After the slurry has been spread on a wooden surface, it should be scrubbed two or three times in a 10- to 15-minute period, after which the completeness of decontamination should be tested. If undecomposed agents can still be found, decontamination must be repeated as soon as the previously applied slurry has been removed. The second application of slurry must also be removed upon completion of the process. One must remember, that a slurry only decontaminates the surfaces of wooden objects. Consequently, the agent may "sweat out" from the deeper layers of wood after 2 or 3 days. In such cases decontamination with slurry must be repeated. Streets, squares, yards, and bridges can be crossed in ordinary footgear within 30 minutes after completion of decontamination with powdered decontaminating agents or with slurries made of these, or after decontamination with aqueous solutions of liquid decontaminating agents. Thirty minutes is essential for effective chemical reaction between the decontaminating agents and chemical agents involved.

When temperatures below 50C prevail, bridges having artificial surfaces should be decontaminated with solutions made of sulfuryl chloride and dichlorethane. Bridges can be crossed (in ordinary footgear) within 15 minutes after decontamination by this means. If the bridges were covered with deep snow prior to contamination, decontamination should be carried out with snowplows and snowshovels, or with other snow-removal vehicles. Small areas should be decontaminated with shovels, picks, mattocks, and scrapers. Snow removed from decontaminated areas should be dumped away from populated areas in specially reserved and enclosed places, where it can be left until spring or until it can be melted by snow thawers. All contaminated water thus produced should be made harmless with bleaching powder (1 kg/cu m of water).

An open field is difficult to decontaminate because drops of persistent agents penetrate the soil to a depth of 10 cm or deeper. During decontamination of open fields by chemical means, the contaminated area should be sprinkled with bleaching powder or sprayed with solutions of liquid decontamination agents. After sprinkling with bleaching powder, the soil should be sprayed with water, then loosened up with shovels and rakes, and, finally, stirred with brooms or stiff brushes.

If the ground to be decontaminated is covered with grass or with other vegetation over 10 cm high, the vegetation must be removed prior to application of the bleaching powder. No vegetation up to 50 cm tall has to be removed, however, if, instead of bleaching powder, solutions of decontaminating agents are used for decontamination.

In a contaminated park or garden, all thoroughfares, walks, and bomb craters should be decontaminated. If contaminated bushes and branches of trees up to 4 m tall adjoin thoroughfares and walks, they must be chopped down and burned. Trunks of contaminated trees should be hosed with high-pressure streams of water.

Small contaminated areas and paths can be decontaminated by scraping and removing the top layer of the ground with roadbuilding machines or regular shovels. Removal of a layer 8 cm to 10 cm deep is usually sufficient, but if the area is highly contaminated, the depth of the scraped ground should be increased to 15 cm.

Scraping contaminated ground with shovels is a very difficult process; such decontamination should, therefore, only be tried on very small sectors. The scraped ground should be removed from populated areas to restricted special places.

A layer of contaminated snow or ice can be removed with snowplows, wooden or steel shovels, scrapers, mattocks, and crowbars. The depth of the layer of snow to be removed should always be 2 cm to 3 cm greater than the depth of the penetration of the chemical agent, which can be readily determined by traces of the agent found in the snow. A 20-cm to 25-cm-deep layer of snow should be removed on the average.

Outside walls of houses and other buildings can be made harmless with a bleaching powder slurry, with local decontaminating materials, or with solutions of liquid decontaminating agents. The slurry should be spread uniformly with soaked bast brushes or with other brushes after all contaminated places have first been sprayed with water. After scrubbing these places two or three times, the completeness of the decontamination is tested. If

necessary, decontamination should be repeated but only if the slurry, i.e., the slurry already applied, has been removed.

Roofs of houses should be decontaminated only if the vapors of agents can be carried by the wind to neighboring houses, or if the vapors can penetrate neighboring houses through the air intakes of ventilators. Highly contaminated roofs should be washed with a slurry of bleaching powder, with solutions of liquid decontaminating agents, or be decontaminated by local decontaminating methods, and should be scrubbed with mops (brooms, brushes, etc) and hosed with high pressure streams of water. If roofs are just slightly contaminated, washing with water is sufficient. Roofs built of battens or shingles should be decontaminated with a slurry made of bleaching powder. All waste water from washed roofs should be led to a sewer system; if none is available, the waste water should be trapped in a cesspool.

All inside premises of buildings to be decontaminated should first be emptied of all objects that can hinder the work. Contaminated walls, ceilings and floors, and all wooden objects should be decontaminated with a slurry. Door knobs and window grips, latches, hinges and other metal parts, and glass windows should be decontaminated with a slurry or bleaching-powder paste, and then washed with water and wiped dry. They can also be wiped two or three times with a rag saturated with kerosene or gasoline. All premises should be washed with hot water and soap upon completion of decontamination.

During decontamination of the inside premises of industrial installations, care should be taken that decontaminating agents containing active chlorine do not drip on machines, electrical equipment, or other valuable objects that can be damaged.

All inside accommodations contaminated by lewisite or other agents of the Sarin type should be decontaminated by the application of aqueous solutions of alkali.

Equipment, machines, and solid metal objects should be decontaminated with solutions of dichloramines and hexachloromelamine or washed with kerosene, gasoline, or other solutions. All contaminated objects should be sprayed with decontaminating solutions using devices found in decontamination kits, or they should be wiped by hand with a rag saturated with these solutions. After decontamination, the surfaces should be wiped dry and, if necessary, coated again.

Prior to decontamination, all visible drops or spots of chemical agents and grease and dirt should be wiped off contaminated surfaces. The

surfaces to be decontaminated should be washed two or three times with solutions and then wiped dry with a rag; a fresh solution and a clean rag should be used each time, because, being contaminated, they constitute a danger to the users. Precautionary measures must, therefore, be taken during decontamination and the solutions and the rags used should be destroyed (burned) after decontamination.

Rough metal and wooden objects can be decontaminated with a slurry made of bleaching powder or with a solution of sodium sulfide; if these are not available, the objects should be washed several times with a hot-water solution of soap and washing soda.

Metal objects not spotted by agents can be decontaminated with hot water and steam. Small instruments and other metal objects that would not be affected by boiling water can be decontaminated by boiling for 30 to 40 minutes and then left to dry; they can be wiped later.

Vehicles will be treated at special stations for decontamination of vehicles (SDT) or at decontamination points (DP).

Different methods of decontamination will be used for various sections and parts of vehicles, according to the material of construction and the type of contamination.

Rubber tires can be decontaminated with a slurry made of bleaching powder. Wooden parts should also be decontaminated with a slurry or should be sprayed with liquid decontaminating agents.

Metal and glass parts can be decontaminated with liquid decontaminating agents or with solvents; precision metal tools will be decontaminated with solutions made of monochloramine B, or washed with solvents.

Railroad and trolley-car lines should normally be decontaminated with the same means and in the same way as the ground.

Clothing, linen, shoes, gas masks, items for skin protection, and household articles should be decontaminated at clothing decontaminating stations (SDO) or at temporary decontamination points, depending upon the type of contamination and the material of the contaminated articles. Various decontaminating methods (ventilation, boiling in water, steam-ammonia or steam-air-ammonia processes, and decontamination agents and solvents) can be used.

Articles contaminated by vapor or fog of persistent agents should

be aired for 2 or 3 hours in the summer and for 6 to 8 hours in the winter. If the same articles have been exposed for a longer period (over 2 hours) to high concentrations of vapor of persistent agents, airing should last longer; 1 day in summer and 2 or 3 days in winter.

Objects contaminated by liquid agents can also be decontaminated by airing although this method does not always bring positive results and usually lasts a long time. Thus, clothing and delicate household articles made of cloth, wool, cotton, and linen fabrics must be aired for 8 to 10 days during summer, and for 20 to 25 days during winter; rubberized fabrics and fabrics impregnated with linseed oil require 15 to 20 days of airing during the summer, and 30 to 35 days during winter. Leather articles should be aired 6 to 10 days in the summer, and 10 to 15 days in the winter.

Objects contaminated by viscous agents should not be decontaminated by airing.

Contaminated articles should be aired outdoors on ropes, hangers, fences, etc. To speed airing of clothing, they should be hung spread out and their position should be changed several times.

All types of articles made of cotton, linen, half-wool yarn, and rubber, rubberized items, and small objects made of metal, glass, and porcelain can be decontaminated by boiling. Many agents that disintegrate in boiling water form hydrochloric acid, which is harmful to the fabric. Disintegrating lewisite, for example, forms beta-vinyl chloride arsine oxide, which is toxic and irritates the skin. To neutralize hydrochloric acid and the oxide, boiling should be carried out in a 2% solution of sodium carbonate. A double amount of ashes can be substituted for the washing soda.

Articles made of cotton, linen, and half-wool fabrics, and metal and porcelain items should be boiled for 30 minutes. Rubber and rubberized articles must be boiled for 1 hour.

Decontaminated clothing and linen should be washed with soap and left to dry. Articles made of rubber and rubberized items should be rinsed in cold water and left to dry. Metal, glass, and porcelain items should be rinsed in hot water and wiped dry.

Clothing made of wool, fur, or quilting, leather articles, felted footwear, and similar items, which can be damaged by boiling, should be decontaminated by the steam-ammonia process or by the steam-air-ammonia method. The latter is the most effective decontamination method for various objects contaminated by chemical agents.

10. Decontamination of Food and Drinking Water

Food and drinking water contaminated by persistent agents present a great danger to the public. Decontamination of food and drinking water is difficult and not always effective. It is necessary, therefore, to adopt all possible measures for protecting food and drinking water against contamination. These measures were explained previously, but many situations could develop in which decontamination of food and drinking water would be necessary.

Food and water exposed to vapor of persistent agents become contaminated only to a small extent. After the odor of the agent is eliminated by airing and after washing and boiling, food, except fats, which became highly contaminated, can be consumed. Water exposed to the effects of vapor of persistent agents is safe for drinking only after boiling.

If traces of drops of agent are found on products such as sugar, butter, cereals, confections, etc., they should be destroyed, or used for some technical purpose.

If only the surface of groats, flour, and other loose products are contaminated by liquid agents, the surface layer should be removed and the remainder should be decontaminated by airing to eliminate the odor of the agent. The products should then be washed, cooked, baked, etc. Contaminated containers used for packing such products should be emptied and destroyed. All decontaminated food can only be used after it has passed inspection of its sanitary condition.

Unopened canned goods are not affected by chemical agents. Drops of agent settled on cans can be washed with hot alkali and soap solutions or cleaned mechanically.

Water stored in tightly covered metal or glass containers is protected against contamination. The containers should be decontaminated in the same way as canned goods.

Water contaminated by liquid agents that has not been decontaminated remains unfit not only for drinking but also for washing, laundering, and other household uses.

Decontamination of water is carried out with sand filters and by processing with special chemicals.

11. Decontamination of Objects Exposed to Persistent Agents.

Nonpersistent agents dissipate rather quickly in open air. Decontamination of polluted air is, therefore, needed mostly in stagnant places. It is necessary next to decontaminate bomb craters left by exploded chemical aerial bombs in order to eliminate the spread of vapors from the craters. Under certain conditions it is also necessary to decontaminate rooms, clothing, food, and various other objects.

The basic method of decontaminating air, quarters, various objects, and food is by airing, which can be speeded up by creating drafts or air surges by heating objects to be decontaminated, etc. Small bonfires that cause drafts of air can also speed the dissipation of agents in stagnant areas considerably.

Craters formed by chemical aerial bombs and in which vapors of nonpersistent agents spread can be filled with dirt, flooded with water, or sprayed with solutions of decontaminating agents.

Clothing, footwear, and food should be aired until the odor of agent has vanished. Slightly contaminated water should be boiled. If water contaminated by nonpersistent arsenical agents (e. g., adamsite), decontamination by special filters is necessary.

If rooms are filled with contaminated air impossible to root out by created drafts, heated stoves, and other mechanical means, the rooms should be decontaminated by chemical means; e. g., by decontaminating solutions sprayed from portable decontamination devices or from other sprayers.

The following composition is used in decontamination solution for decontamination of phosgene and diphosgene: hyposulfite, 30 gm; soda, 60 gm; and caustic soda, 5 gm, per liter of water. A 10% aqueous solution of ammonia may also be used.

Air contaminated by prussic acid can be decontaminated by spraying a 27% solution of formaldehyde or a solution of 50 gm of iron vitriol (50 gm of copper sulfate) per liter of water.

12. Safety Measures During Decontamination.

As a rule, decontamination should be carried out by personnel of the MPVO. The public can only be allowed to perform very simple decontamination tasks, such as ventilating rooms and contaminated objects.

Personnel carrying out decontamination by nonpersistent agents must wear gas masks. When decontamination rooms filled with carbon monoxide, it is necessary to use a hopcalite and isolating gas mask.

During decontamination of streets, yards, squares, and buildings contaminated by persistent agents, teams that come in contact with liquid agents and are exposed for a long time to irritant vapor of agents that touch the skin, must wear gas masks and protective clothing.

If decontamination involves objects contaminated by persistent agents, and if decontamination will be performed outside the contaminated area or locality involved (decontamination of automobiles or household items from buildings to decontamination stations), gas masks, protective aprons and gloves must be worn.

The routes of the personnel where decontamination of various objects takes place must be distinctly marked. Personnel employed at decontamination stations can leave their place of work only via the indicated exits and protective gloves and footwear must be decontaminated before the wearer reaches the exit.

Decontamination personnel should put on protective items in designated places located where there is no possibility of becoming contaminated. All rags, fiber packing, and other pieces of waste used during decontamination should be thrown into a specially excavated hole or deposited in boxes to be destroyed after decontamination (burned or buried).

One should avoid all contact with contaminated objects. Smoking, drinking, eating, sitting, kneeling, or carrying out body functions are not permitted in places where decontamination is being carried out.

After decontamination has been completed it is necessary to avoid infecting oneself.

13. Utilization of Decontamination Devices for Disinfection and Deactivation.¹

Many decontaminating agents that contain active chlorine, decontamination devices and vehicles, and special equipment for decontaminating clothing and vehicles can all be used for disinfection purposes if they are used in a special way.

1. The term deactivation is most often used to denote the process of rendering radioactive objects or places harmless.

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During deactivation of a locality contaminated substances, roadbuilding machines used for decontaminating mobile refueling stations (ARS), watering vehicles, snowplows, and hand-operated and mechanized sprayers can

Various solvents (gasoline, kerosene, alcohol) deactivate equipment, inside premises, vehicles, motor vehicles, etc. contaminated by radioactive substances. These are used to decontaminate motor vehicles and devices and are adopted for the atomization of liquids.

In order to carry out deactivation, all decontaminating vehicles and devices that use decontaminating solutions filled either with water, with solvents, or with solutions

or objects are contaminated by germs and toxins.

During deactivation of a locality contaminated by radioactive substances, roadbuilding machines used for decontamination, vehicles of mobile refueling stations (ARS), watering vehicles, sweeper vehicles, snow-plows, and hand-operated and mechanized sprayers can all be used.

Various solvents (gasoline, kerosene, alcohol, etc) can be used to deactivate equipment, inside premises, vehicles, motor vehicles, machinery, etc contaminated by radioactive substances. These solvents can also be used to decontaminate motor vehicles and devices and appliances that can be adopted for the atomization of liquids.

In order to carry out deactivation, all decontamination motor vehicles and devices that use decontaminating solutions and solvents can be filled either with water, with solvents, or with solutions of washing compounds.

CHAPTER III

PROTECTIVE MEASURES AND RULES FOR PUBLIC CONDUCT

Upon announcement of the existence of "Critical Situation" in an inhabited area, all civilians should seek safety for themselves and their families, and should secure individual means for protection, which should be constantly available.

Measures should be taken at home to protect food, water, and household commodities against contamination by chemical agents.

Self-defense groups in residential sections should meet at their assembly points to check and ready their equipment for action to provide protection. Decontamination personnel should assemble decontaminating devices (if they are not already present), removing all excess grease from stored parts; personnel should procure and have ready all emergency material needed for construction of floors in contaminated areas.

Arrangements should be made for shelters to be ready for the admittance of the public.

Signaling apparatuses should be tested to sound the warning signal: "Chemical Attack."

When the "Air Alarm" signal is given the following measures for protection must be adopted.

All civilians outside their homes who hear the signal should secure their gas masks and bring other means of protection to the state of "readiness;" they should then either proceed to shelters or assume some assigned administrative duty.

Civilians at home should procure their gas masks and other means of protection for themselves and for their children, and should then bring these means to the state of "readiness" and proceed to shelters or to some other places of concealment.

Personnel of the self-defense groups in residential sections should proceed to their assembly points where they can inspect the equipment issued to units and to individual operators. The individual means for anti-chemical protection should be brought to the state of "readiness."

Teams in charge of shelters should provide room for persons seeking cover and control the operation of ventilating systems. (Outside air is brought into shelters after passing through absorbent filters.)

The chemical-attack signal is sounded after the use of agents by enemy aircraft or the use of radioactive combat substances and bacteriological weapons has been detected. The explosion of an atomic bomb should also be regarded as a chemical-attack signal. Depending upon the size of the contaminated area, the signal may be citywide or local. A local signal affects only the limited region or sector where it was sounded. A citywide signal will be transmitted over the a-f rediffusion net¹ with the oral warning: "Civilians, this is chemical-attack." Subsequently, an announcement may follow giving the boundary of the contaminated area, itineraries and evacuation routes leading from contaminated areas, other information needed for a properly organized evacuation of the public from contaminated regions, and information to help curtail losses resulting from chemical attack. A local chemical-attack signal will be sounded orally or by hammering on pieces of rail, gongs, etc.

Following the signal, all civilians present in shelters provided with chemical protection equipment will remain there and will follow the instructions of the shelter commandant. (The commandant in charge of the shelter's team is usually the shelter commandant.)

All civilians in shelters not outfitted with chemical protection equipment, or civilians, who for some reason are outside shelters or in places of concealment, should immediately put on their gas masks and make use of other individual means of protection. They should, subsequently, evacuate contaminated areas and proceed to the sectors indicated by guards of the MPVO.

If toxic, radioactive, or bacteriological weapons are used during the attack of enemy aircraft, one of the guards of the self-defense team should give the chemical-attack signal. Personnel in charge of shelters should switch on the ventilators to operate through absorbent filters.

Following the signal, the self-defense team should bring all individual means for protection to combat readiness. The team should then determine the extent of contamination by areas and places where stagnant contaminated air is trapped; all sources of contamination should be marked off and warning signs displayed in the sectors of each team. Contaminated sections of walls should be marked along the lateral borders by drawing visible

1. The a-f rediffusion net is a high-power a-f amplifier feeding into a local wire broadcast network.

chalk or carbon lines, and the arrows should point to the contaminated spots. Contaminated houses should be marked on the doors with chalk or carbon with the word contaminated.

Operations and rules for the conduct of self-defense teams and the public at sources of chemical contamination. All craters of chemical aerial bombs should be made harmless by decontamination teams of the self-defense groups. The team should, if necessary, build paths or floors through contaminated areas to evacuate the public from shelters and other premises. The decontamination of large sectors of contaminated areas should be carried out, not by self-defense teams, but by units of the MPVO.

Evacuation of the public from a contaminated area should also be carried out by self-defense teams. Civilians must wear gas masks while going through passages not decontaminated, and must use emergency means for skin protection prior to evacuation. A gas mask is sufficient for crossing decontaminated paths or floors. Civilians going through contaminated sectors must carefully watch for direction and itinerary signs; no one is allowed to enter any building or to touch any contaminated object; sitting down and resting are prohibited; the no-smoking, eating, and drinking rules must be enforced.

Civilians evacuated from a contaminated area will follow the instructions of the MPVO guards, who should guide them to the nearest assembly points. All means of protection will be removed at assembly points, and a thorough sanitary processing will be carried out. Some civilians will be directed to disinfection stations, if necessary, or to sanitary processing stations, where they will receive medical examination and emergency treatment after disinfection. Clothing, linen, and footwear of all civilians will be decontaminated at this time, and everyone will be thoroughly disinfected. Civilians will be able to return to their homes only by permission of the MPVO guards as soon as all decontamination work has been completed. The MPVO personnel will direct all who need lodging to specially reserved buildings.

Decontamination personnel of self-defense teams should carry out only simple decontamination tasks at the sources of contamination. Upon completion of the work, the personnel will decontaminate all equipment used. All rags, waste material, mops, etc used for decontamination must be destroyed. After this, personnel of the self-defense teams, who have been at the source of chemical contamination, must be directed to the nearest disinfecting station (or to the sanitary processing station) to receive a thorough sanitary processing.

Self-defense teams must make all equipment ready for further enemy air attacks, and all used-up decontamination agents must be replenished. Upon completion of all the work at the source of contamination, and upon elimination of all of the aftereffects of the enemy air attack, the personnel of the self-defense teams may be dismissed.

Arkadiy Arkadevich Malshinskiy

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